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ABSTRACT

This publication, one of a series of instructional manuals for industrial arts education, is designed to assist teachers as they plan and implement new courses to create environments that integrate classroom learning with students' real life experiences. The material is organized in seven instructional units. Each unit consists of objectives, key words (vocabulary), teaching aids (including transparencies), suggested references, a sentence outline of the unit, materials for students (such as exercises, charts, and graphs), suggested student activities, tests, and test keys. The seven units cover the following topics: introduction to computer applications, industrial computer applications, management information systems, computer-aided manufacturing, computer-aided drafting, computer numberical control, and robotics. Computer programs for various applications are printed in appendixes to the document. (KC)

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CE 041 728

Computer Applications in Technology

By

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and

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Foreword

This publication is one of the new series of instructional materials for industrial arts education. It is designed to assist teachers as they plan and implement new courses of study and make revisions and improvements in existing courses. This publication is intended to help industrial arts teachers create learning environments that respond to the needs of students growing up in a complex industrial-technical society. It provides a framework that enables teachers to integrate classroom learning with real-life experiences of students.

Industrial arts is being challenged to expand and clarify its function. To meet this challenge, the industrial arts curriculum must provide opportunities for students to learn more about the technological realities in our society. This publication provides teachers with an instructional platform that focuses on industrial arts' commitment to establish its content base in the technologies.

Every effort has been made to produce a publication that addresses the unique needs of our current student population. Students with limited English proficiency (LEP) as well as handicapped, educationally disadvantaged, and nontraditional students may require modification of the material in this publication. The professional staff of EIMC will gladly work with any instructor having those students to show how the instructional material can be adapted for specific individualized instruction. Consult local, state, and federal agencies that offer assistance and guidance and that can provide sound recommendations for productive classroom management.

Kathryn R. Allen, Ph.D.
Director, Extension Instruction
and Materials Center

COMPLIANCE STATEMENT

TITLE VI, CIVIL RIGHTS ACT OF 1964; THE MODIFIED COURT ORDER, CIVIL ACTION 5281, FEDERAL DISTRICT COURT, EASTERN DISTRICT OF TEXAS, TYLER DIVISION

Reviews of local education agencies pertaining to compliance with Title VI Civil Rights Act of 1964 and with specific requirements of the Modified Court Order, Civil Action No. 5281, Federal District Court, Eastern District of Texas, Tyler Division are conducted periodically by staff representatives of the Texas Education Agency. These reviews cover at least the following policies and practices:

(1) acceptance policies on student transfers from other school districts;

(2) operation of school bus routes or runs on a non-segregated basis;

(3) nondiscrimination in extracurricular activities and the use of school facilities;

(4) nondiscriminatory practices in the hiring, assigning, promoting, paying, demoting, reassigning, or dismissing of faculty and staff members who work with children;

(5) enrollment and assignment of students without discrimination on the basis of race, color, or national origin;

(6) nondiscriminatory practices relating to the use of a student's first language; and

(7) evidence of published procedures for hearing complaints and grievances.

In addition to conducting reviews, the Texas Education Agency staff representatives check complaints of discrimination made by a citizen or citizens residing in a school district where it is alleged discriminatory practices have occurred or are occurring.

Where a violation of Title VI of the Civil Rights Act is found, the findings are reported to the Office for Civil Rights, Department of Health, Education and Welfare.

If there is a direct violation of the Court Order in Civil Action No. 5281 that cannot be cleared through negotiation, the sanctions required by the Court Order are applied.

TITLE VII, CIVIL RIGHTS ACT OF 1964: EXECUTIVE ORDERS 11246 and 11375; TITLE IX 1973 EDUCATION AMENDMENTS: REHABILITATION ACT OF 1973 AS AMENDED; 1974 AMENDMENTS TO THE WAGE-HOUR LAW EXPANDING THE AGE DISCRIMINATION IN EMPLOYMENT ACT OF 1967; VIETNAM ERA VETERANS READJUSTMENT ASSISTANCE ACT OF 1972 AS AMENDED IN 1974.

It is the policy of the Texas Education Agency to comply fully with the nondiscrimination provisions of all federal and state laws and regulation by assuring that no person shall be excluded from consideration for recruitment, selection, appointment, training, promotion, retention, or any other personnel action, or be denied any benefits or participation in any programs of activities which it operates on the grounds of race, religion, color, national origin, sex, handicap, age, or veteran status (except where age, sex, or handicap constitute a bona fide occupational qualification necessary to proper and efficient administration). The Texas Education Agency makes positive efforts to employ and advance in employment all protected groups.

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Notes to the Teacher

Using the Curriculum Material

Intended Audience. The material in this curriculum package is designed for use by industrial arts teachers in all secondary program areas.

Length of Time for the Material. The topic of study has been developed to provide enough material for eighteen weeks of study. Individuals who teach six-, nine-, or twelve-week classes can select parts of this curriculum material as the substance of their classes.

Emphasis of the Material. Keep in mind that this curriculum is exploratory in nature. The emphasis is on exposing students to a wide range of experiences within the topic of study rather than on the development of technical expertise in one area.

Benefits for Teachers and Students. This material is designed to assist industrial arts teachers in the classroom as they reinforce and enhance the student's skills in reading, mathematics, communications, problem solving, and social interaction. In addition, teachers who use this curriculum material will be able to help their students gain an understanding of and appreciation for management and work skills needed by individuals in the world of work. The broad exposure students receive in the topic of study will assist them in making meaningful career choices.

Flexibility of the Material. This curriculum material, like any other material, cannot encompass all situations. Therefore, teachers should feel free to supplement the material with other ideas, information, or activities as needed in their particular programs.

This material can be used in a number of different ways by industrial arts teachers. Some teachers may desire to use it as the starting point, a foundation upon which to build their own courses of study. Other teachers may prefer to teach the material as it is and add to it as they feel the need. Still other teachers may pick and choose only selected parts of this curriculum for use in their classes.

Teachers may also need to make substitutions in the curriculum, depending on the equipment or references available. Other circumstances may also require teachers to make curriculum substitutions. The flexibility of this material enables teachers to use it in various ways and under various conditions. This curriculum provides teachers with an alternative in course design.

Competencies. Competencies have been identified for the topic of study. As used in this material, competencies represent skills, knowledge, or attitudes that imply the ability or intelligence to accomplish a task or job. They represent the instructional intent and are stated as specific goals to be achieved. Competencies assist teachers and students in clearly formulating a purpose for learning.

Organization of the Curriculum Material

The material in this topic of study is organized into instructional units. The framework used to develop each unit consists of a number of components. These components focus on (1) outcomes, (2) materials, (3) content, (4) activities, and (5) evaluation. The components are further divided and standardized in each topic of study. An explanation of each part in the instructional unit follows.

Objectives. Objectives have been identified for each instructional unit. The objectives reflect the kind of performance necessary to successfully complete a task or job. These objectives enable a student to attain the stated competencies. Furthermore, each unit's objectives are reflected in the content, student activities, and tests for that unit.

Objectives help the teacher and the student to focus upon the important concepts to be learned in each unit. Teachers may want to duplicate the competencies and objectives and give them as handouts to the students.

Key Words: Vocabulary. New words or terms are listed to enable you to help students develop their vocabulary. Some words or terms may be listed in several units because they are used throughout a topic of study. The repetition helps reinforce vocabulary building. A student vocabulary worksheet is included with each unit.

Teaching Aids. The materials, equipment, and supplies identified in this section will enable the teacher to plan and organize instruction better. Teachers need to review this list of teaching aids before the day of instruction since some substitutions in equipment may be needed under certain conditions. A test key has been included to help the teacher in correcting the unit test.

Each transparency in this unit is also listed and briefly described. Transparency masters are provided at the end of each unit. The transparencies are keyed to a point in the sentence outline where their use is considered most appropriate. In addition to being used as transparencies, the masters may be duplicated and used as student handouts if the teacher so desires. Teachers may design or develop other transparency material that they feel enhances their instruction.

Suggested References. Many of the publications listed are available from textbook publishers. The material listed in this section is suggested for use by teachers as a way to supplement their knowledge in the subject area. Teachers can review these references and use selected material as supplements to their lectures and demonstrations when appropriate. Some of the sources suggested offer free or inexpensive materials that teachers may use with their students.

Sentence Outline. The information presented in this section represents the conceptual focus of the unit. The ideas and concepts are presented in a sentence outline, as a guide from which to teach. The outline should serve as a reference from which teachers can provide instruction.

The intent was not to needlessly duplicate material that is readily available to teachers. Rather, the intent was to provide teachers with basic ideas and information that may be less accessible. The suggested references and other resources can be used by teachers to build a knowledge base from which they can synthesize relevant concepts and information. Suggested references can be used to supplement, expand, and clarify learning activities and instruction.

Materials for Students. Suggestions to teachers regarding student materials may also be listed here. Student handout materials, such as exercises, charts, graphs, and games are provided at the end of each unit when appropriate. These student handouts immediately follow the suggested student activities section. Handout materials may be reproduced and given to students.

Suggested Student Activities. The suggested activities are designed to reinforce and provide real applications of the concepts and content within each unit. These activities have been designed to use existing facilities and equipment, as much as possible. Another consideration was the cost factor. Suggested activities are designed to require minimum cost.

Each teacher should, therefore, examine the activities and select those which are appropriate for their students. Teachers can change or modify the suggested activities if equipment, materials, and funds are not available. Teachers need to be selective in the activities they use since some activities take longer than others. Some are designed for group activity while others are for individual work. The teacher's content emphasis must also be considered. Each of the activities has been designed to reinforce and enhance basic skills that students need in everyday life.

Tests. Each unit has a multiple-choice test to assist teachers in evaluating student achievement. Multiple-choice tests provide certain advantages for teachers in evaluating the teaching-learning process. They do not capitalize on chance answers to the extent that true-false tests do. Careful development of test answers will help teachers evaluate a student's comprehension of important concepts. This also provides teachers with an easy way to assess the effectiveness of their instruction through item analysis.

Written tests are only one method of assessing learning. Teachers will also need to evaluate a student on actual performance in each activity, on abilities, and on general progress toward reaching objectives. Each teacher should develop an evaluation system that provides the most accurate assessment of a student's progress.

Teachers may prefer to develop their own test instruments. However, their test items should focus upon objectives and course content. The test for each instructional unit in this curriculum material does focus on the objectives stated at the beginning of each unit and on unit content. A test key is also provided in the teaching aids section of each unit for the teacher's use in correcting tests.

Essential Elements

I. Essential Elements Common to All Vocational Education Programs
  A. Leadership concepts and skills
    The student shall be provided opportunities to—
    1. identify characteristics and responsibilities of leaders and effective group members;
    2. participate in orderly meetings conducted according to parliamentary procedure;
    3. function effectively on committees;
    4. plan and conduct leadership activities; and
    5. prepare for effective citizenship and participation in our democratic society.
  B. Concepts and skills related to successful employment
    The student shall be provided opportunities to—
    1. develop an awareness of employment opportunities in a chosen field;
    2. practice correct procedures for job application and interview;
    3. develop the ability to take and follow both oral and written directions;
    4. practice punctuality and dependability;
    5. observe rules and standards of the workplace;
    6. demonstrate an ability to work with others harmoniously;
    7. develop responsibility and the ability to follow through on assigned tasks; and
    8. exhibit productive work habits and attitudes.
  C. Concepts and skills associated with entrepreneurship
    The student shall be provided opportunities to—
    1. recognize opportunities and options for business ownership;
    2. identify entry-level procedures, planning processes, and terms needed to open a business; and
    3. develop an understanding of the role of small business in the free enterprise system.

II. Essential Elements Common to All Industrial Arts Programs
  A. Concepts and skills in the application of safety procedures
    The student shall be provided opportunities to—
    1. demonstrate safe operation and use of selected tools and equipment to avoid injury; and
    2. maintain safe conditions in the laboratory.
  B. Concepts and skills related to planning, designing, and problem solving
    The student shall be provided opportunities to—
    1. plan and design industrial products of the student's choice;
    2. measure accurately using metric and customary units;
    3. complete itemized list of materials; and
    4. make working drawings of projects.
  C. Concepts and skills related to the tools, materials, and process of technology
    The student shall be provided opportunities to—
    1. solve industrial problems by using a variety of industrial materials;
    2. use correctly selected hand and machine tools; and
    3. select the most suitable process to complete a project.
  D. Concepts and skills related to the past, present, and future of technology
    The student shall be provided opportunities to—
    1. recognize ideas and inventions of the past and present; and
    2. relate technological change to the skills needed for the future.
  E. Concepts and skills related to evaluating products and services of technology
    The student shall be provided opportunities to—
    1. recognize good design and construction;
    2. evaluate products based on given standards or applications;

   3. service industrial products and equipment; and
   4. develop criteria for selecting, purchasing, and contracting services.

III. Concepts and Skills Related to Production Technology

The student shall be provided opportunities to—

- A. apply industrial organization and management systems by planning, organizing, and controlling production processes;
- B. apply primary industrial processes of layout, testing, separating and cutting, drilling and boring, shaping and forming, casting, laminating, coating, decorating, joining, and finishing;
- C. research the recycling of industrial materials;
- D. plan and implement the various steps in the construction process;
- E. research the transformation of raw materials into finished products;
- F. plan and implement mass production activities;
- G. demonstrate techniques and processes used in automated production systems; and
- H. use computers in planning, production, quality control, and management of production systems.

IV. Concepts and Skills Related to Visual Communications Technology

The student shall be provided opportunities to—

- A. make freehand technical drawings;
- B. apply accepted lettering practices and styles;
- C. construct multiview projections with instruments;
- D. describe object size by standard dimensioning practices;
- E. describe objects through pictorial methods;
- F. apply design principles to composition and layout techniques;
- G. operate standard reproduction and duplicating equipment;
- H. use standard finishing techniques;
- I. produce products using accepted methods of image generation;
- J. study the types and uses of visual communications equipment;
- K. use computer software to design and make drawings;
- L. explore the use of function codes in computer numerical control of production machines; and
- M. use data base software to assist in collecting, storing, retrieving, and applying information for industrial applications.

V. Concepts and Skills Related to Energy Technology

The student shall be provided opportunities to—

- A. use apparatus and devices that demonstrate the generation, conversion, and control of mechanical, electrical, and pneumatic-hydraulic power;
- B. construct static or working models or examples of devices that generate, convert, or control energy;
- C. utilize computers for the collection and analysis of data relevant to energy technology;
- D. compare transportation systems that move people and materials by land, sea, air, and space;
- E. plan and implement the controlled movement of robots;
- F. use instrumentation with computers to monitor data-based systems;
- G. compare transmission systems that move energy by electrical, electronic, mechanical, and pneumatic-hydraulic technologies;
- H. construct static or working models that demonstrate devices or systems used to move people and materials;
- I. construct static or working models that demonstrate devices or systems that transmit energy; and
- J. read and interpret maps, charts, and schedules.

Competencies

- Become aware of the many uses of computers in industry.
- Describe the need for different computer languages used in industry.
- Use different types of input/output devices to simulate those used in industry.
- Control movements of robotic components.
- Simulate the use of robots to control industrial processes.
- Study the function codes of computer numerical control.
- Use computer numerical controlled machines to produce industrial products.
- Use computer-aided drafting to make working drawings.
- Simulate the use of computer-aided manufacturing to plan, produce, control, and manage manufacturing processes.
- Use computer image generation methods to communicate information.
- Use data base software to assist in collecting, storing, retrieving, and applying information for industrial applications.
- Use industrial simulation and modeling to solve problems.
- Study future uses of computers in industry.

Background Information

OBJECTIVES

- To provide information for supervisors and teachers of industrial arts in the area of computer applications
- To provide a sample of basic commands used on selected microcomputers
- To provide sample hardware and software specifications
- To provide a guide to selection of software
- To familiarize the teacher with the operational differences that result from more user-friendly software
- To identify how computers are used with special needs students
- To identify the need to update teacher information in the future

SENTENCE OUTLINE

I. Introduction

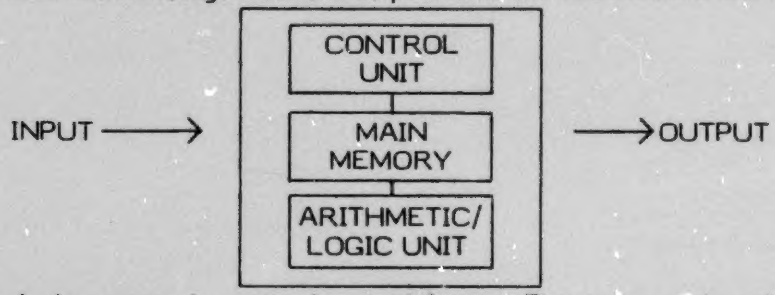
A. Computer hardware

The computer is a complex electronic device, basically capable of reading (input), writing (output), and processing information. The processing of information, or data, basically consists of adding, subtracting, multiplying, dividing, and comparing data. The computer consists of three major parts:

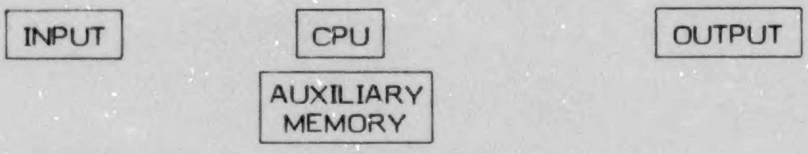
1. Input devices
2. Main computer (CPU)
3. Output devices

Further, the main computer or CUP (Central Processing Unit) has three main parts:

1. The control unit determines the order in which the computer will perform instructions.
2. The main memory stores the data and the instructions.
3. The arithmetic/logic unit (ALU) performs the calculations and comparisons.



Input devices come in many sizes and forms. There are card readers, keyboards, paper tape readers, joysticks, cassette tapes, magnetic disks, digitizers, sensors, and others. Output devices include line printers, character printers, card punches, paper tape punches, video screens (CRTs), cassette tapes, magnetic disks, plotters, robots, machine controllers, and others. Some devices are both input and output devices: magnetic tape drives, cassette tapes, magnetic disks, and others. Magnetic tapes and disks, as well as some other "peripheral" (input and/or output) devices, are also used as auxiliary memory. These devices are connected to the CPU in the same was as other input/output devices, but are often used to save data too large to keep in the main memory.



B. Computer software

A computer is capable of performing a wide variety of calculations, but it must be "instructed" for each step of its operation. Computer instructions are coded in "machine language" and stored in the computer memory before the instructions are executed by the computer. A group of instructions that tells the computer how to perform a complete task is called a computer "program" or "software."

There are two kinds of computer software. **Operating systems programs** are programs the computer vendor provides that instruct the computer to permit people to create, load into memory, and run other programs. Typical things a computer can do by following the instructions of operating systems programs are:

1. list which programs are in memory;
2. list the instructions in a program;
3. permit a new instruction to be placed in a program;
4. permit an instruction to be changed in a program;
5. translate program instructions from "human" language to machine language;
6. save a program into auxiliary memory;
7. load a program from auxiliary memory; and
8. run a program.

Other computer programs are often called **"application" programs.** These programs instruct the computer to perform payroll calculations, prepare a mailing list, make a drawing, operate a machine or robot, play a game, or some other task. Application programs may be furnished by the computer vendor, purchased from a software vendor, or written by you, a student, or a friend. Application programs are usually written (programmed) in a "human" language rather than a machine language. They must be translated into machine language (by the operating system programs) before they can be "executed" (run). We say a program is "executed" when the computer is following its instructions. BASIC is one of the more popular human languages used to write computer programs.

C. Computer operations

When operating a computer keyboard, a person is doing one of three things:

1. giving the computer commands;
2. entering the instructions of a program; or
3. entering data for a program that is being run.

After going through a single start-up "boot" procedure, a person generally gives the computer one or more commands. The commands are read, interpreted, and followed by the operating system programs. For example, one may ask for a particular program (that has been previously written) to be "loaded" into the main memory and compiled (or translated into machine language). Then one can ask for the program to be "run." When receiving and performing commands, the computer (hardware) is executing (following) the instructions of an operating system program (usually called the executive) that is interpreting the command and performing the requested task.

If a person issues a command to "run" a particular application program, the computer is then told by the executive program to start following the instructions in the requested program. That program may then cause the computer to ask for input data. The person then keys in data or information that will be used by the application program.

When a program is to be created or modified, the keyboard operator issues a command to the executive program to "run" another operating system program, usually called the "editor." The editor saves keyboard entries as instructions in a new program. These instructions are not executed (followed) by the computer as they are entered. They are saved as a group (program) until the keyboard operator later issues a "run" command.

D. Operating Commands for Selected Microcomputers

1. TRS-80 III, 4, or 4P (Registered Trademark)

> prompts character for commands and statements
List -- lists the program currently in CPU memory
Run -- executes the program currently in CPU memory
New -- clears CPU memory for entering a new program
Cload -- loads a program from the cassette
Load -- loads a program from the diskette
Csave -- saves a program on the cassette
Save -- saves a program on the diskette
Dir -- lists the programs (files) on diskette
→ -- moves right (right arrow key)
← -- moves left (left arrow key)
<Enter> -- enter key terminates all commands and statements

To "save" or "load" on the cassette where "A" is the name of the program (file):

```
>Csave "A"
>Cload "A"
```

To "save" or "load" on the diskette where "A" is the name of the program (file) and "d" is the drive number:

```
>Save "A:d"
>Load "A:d"
```

To "list" the program (file):

```
>List—list on CRT
>LList—list on printer (hardcopy)
```

2. APPLE II, II+, or IIe (Registered Trademark)

[prompts character for commands and statements
List -- lists the program currently in CPU memory
Run -- executes the program currently in CPU memory
New -- clears CPU memory for entering a new program
Load -- loads a program from diskette
Save -- saves a program from diskette
Catalog -- lists the programs (files) stored on diskette
→ -- moves right (right arrow key)
← -- moves left (left arrow key)
<Return> -- return key terminates all commands and statements

To "save" or "load" on the diskette where "A" is the name of the program (file) and "d" is the drive number:

```
[Save A, d
[Load A, d
```

To "list" the program (file):

```
[List—list on CRT
[LList—list on printer (hardcopy)
```

3. IBM PC (Registered Trademark)

A< prompts character for commands and statements
List -- lists the program currently in CPU memory
Run -- executes the program currently in CPU memory
New -- clears CPU memory for entering a new program
Load -- loads a program from the diskette
Save -- saves a program to the diskette

Dir or files -- lists the programs (files) on diskette
→ -- moves right (right arrow key)
← -- moves left (left arrow key)
↵ -- bent arrow key terminates all commands and statements

To "save" or "load" on the diskette where "A" is the name of the program (file) and "d" is the drive number:

    Save
    Load

To "list" the program (file):

    List—list on CRT
    LList—list on printer (hardcopy)

4. Franklin ACE 1000 or ACE 2000 (Registered Trademark)

[-- prompts characters for commands and statements
List -- lists the program currently in CPU memory
Run -- executes the program currently in CPU memory
New -- clears CPU memory for entering a new program
Load -- loads a program from the diskette
Save -- saves a program to the diskette
Catalog -- lists the program (files) stored on diskette
→ -- moves right (right arrow key)
← -- moves left (left arrow key)
<Return> -- return key terminates all commands and statements

To "save" or "load" on the diskette where "A" is the name of the program (file) and "d" is the drive number:

    [Save A,d
    [Load A,d

To "list" the program (file):

    [List—list on CRT
    [LList—list on printer (hardcopy)

5. Zenith Z-100 (Registered Trademark)

[-- prompts characters for commands and statements
List -- lists the program currently in CPU memory
Run -- executes the program currently in CPU memory
New -- clears CPU memory for entering a new program
Load -- loads a program from diskette
Save -- saves a program to the diskette
Catalog -- lists the programs (files) stored on diskette
→ -- moves right (right arrow key)
← -- moves left (left arrow key)
<Return> -- return key terminates all commands and statements

To "save" or "load" on the diskette where "A" is the name of the program (file) and "d" is the drive number:

    [Save A,d
    [Load A,d

To "list" the program (file):

    [List—list on CRT
    [LList—list on printer (hardcopy)

II. Selection of Hardware

A. In selecting computer hardware, the prime consideration is to make sure that all hardware is compatible.
B. Computer magazines and journals generally review hardware, and this is a good place to begin your selection process.
C. Visit local computer stores for literature and demonstrations.
D. Discuss computer hardware with colleagues who are already using equipment that meets needs similar to yours.

- E. The following is a sample list of equipment for most technology education activities.
  - 1. General purpose
    - a. microcomputer with double drive disk
    - b. monitor—12" hi-resolution color
    - c. printer
  - 2. Computer-aided drafting
    - a. microcomputer with double disk drive
    - b. digitizing tablet—11" x 11" with puck
    - c. monitor—12" hi-resolution color
    - d. line filter
    - e. software
    - f. student tutorial manual
  - 3. Computer numerical control
    - a. CNC lathe or mill
    - b. CNC simulation software package
    - c. software
    - d. student tutorial manual
  - 4. Robotics
    - a. robot with teach pendant
    - b. robotic simulation software package
    - c. software
    - d. student tutorial manual

III. Selection of Software

- A. Selection of software can be very time-consuming, but it is very important if you are going to get the best buy for your money.
- B. Software can be defined as a set of instructions for the computer.
- C. There are two basic methods of obtaining software:
  - 1. self-developed program on floppy disks—a magnetic tape
  - 2. "canned" software packages on floppy disks—a magnetic tape developed by companies (purchased at computer software stores)
- D. Regardless of what type of software package you choose, make sure it is compatible with your computer and other peripherals.
- E. What is normally included in a software package:
  - 1. floppy disk—a magnetic tape with backup
  - 2. documentation explaining the program and what it does
  - 3. loading and entering information
  - 4. how to obtain results from the program
- F. Tips for purchasing software
  - 1. Determine your needs.
  - 2. Define each computer application requirement.
  - 3. Think about what you will need in the future.
  - 4. Identify and review software needed to meet computer application requirement.
  - 5. Determine how much capacity you will need for the computer application.
  - 6. Compare different systems and the cost.
  - 7. Compare vendors.
  - 8. Seek professional help.
  - 9. Use good judgment.
  - 10. Use a support system.
  - 11. Consult a microcomputer software directory.
- G. Common terms used in the microcomputer software directory
- H. Computer software evaluation form

IV. Computers for Special Needs

- A. The computer provides an effective tool for working with and improving the skills of disabled and disadvantaged people.

B. Joysticks, keyboard eliminators, and speech synthesizers have provided many educational experiences for physically disabled people. Among these are learning, play, and communications.

C. Voice command capabilities of computers allow disabled and disadvantaged people to perform daily activities:

1. answer and dial a telephone
2. operate and control appliances
3. conduct correspondence such as writing and storing letters
4. compose and generate music
5. interact with other computer systems

D. Special computer software packages have been designed to help people with special needs to learn at a faster rate.

V. Updating the Future

A. It is important to constantly make yourself aware of the changes in computer technology.

B. Subscribe to periodicals and journals on computer technology.

C. Attend meetings and conferences on computer technology.

D. Continually review computer software.

E. Continually assess your program, looking to the future, to determine what additional hardware and software will best meet your needs.

1

Introduction to Computer Applications

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. identify types of dedicated and nondedicated computers;
2. identify the main parts of a computer (input, CPU, output);
3. identify common input and output peripherals found in industry; and
4. describe the environmental requirements of a computer.

KEY WORDS: VOCABULARY

The words below may be new to students studying computer applications. Teachers should help students understand these words as they are used in this topic of study.

peripherals
microcomputer
function keys
dedicated computer
nondedicated computer
main frame
minicomputer
personal computer
digital
analog
printer
backup
sound generators
hardware
software
inputs
outputs
I/O
CPU

TEACHING AIDS

- Poster listing steps to operate computer
- Owner's operating manual
- Overhead projector
- Software documentation
- Test Key: 1-B, 2-A, 3-B, 4-D, 5-C, 6-A, 7-B, 8-D, 9-A, 10-B
- Transparencies: You will find transparencies CA1-1 through CA1-4 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to students while they are studying different aspects of this unit.
  CA1-1: Dedicated Computers
  CA1-2: Nondedicated Computers
  CA1-3: Peripherals
  CA1-4: Care of Diskettes

SUGGESTED REFERENCES

Adler, H. 101 Programming Tips and Tricks for the VIC-20 and Commodore-64. New York: Arcsoft Publications, 1982.

Adler, H. 34 VIC-20 Computer Programs for Home, School, and Office. New York: Arcsoft Publications, 1981.

Bertoni, P. Strangers in Computerland. Lexington, Mass.: Lewis Publishing Co., 1983.

Coan, J. S. Basic BASIC: An Introduction to Computer Programming in BASIC Language. 2nd ed. Rochelle Park, N.J.: Hayden Books Co., 1978.

Kemeny, J. G., and Kurtz, T. E. Basic Programming. 3rd ed. New York: John Wiley & Sons, 1980.

Lenk, J. D. Handbook of Microprocessors, Microcomputers, and Minicomputers. Englewood Cliffs, N.J.: Prentice-Hall, 1979.

Luehrmann, A., and Packham, H. Computer Literacy: A Hands-on Approach. New York: McGraw-Hill, 1983.

Machover, C. Display Systems: Computer Graphics. Pittsfield, Mass.: Optical Publishing Co., 1971.

Osborn, A., and Bunnell, D. An Introduction to Microcomputers: Volume O: The Beginner's Book. Berkeley, Calif.: Osborne/McGraw-Hill, 1980.

Scott, J. E. Introduction to Computer Graphics. New York: John Wiley & Sons, 1982.

Sippl, C. J., and Sippl, R. J. Computer Dictionary and Handbook. 3rd ed. Indianapolis: Howard W. Sams, 1980.

Willis, J., and Miller, M. Computers for Everybody, 1984 Buyer's Guide. Beaverton, Ore.: Dilithium Press, 1983.

SENTENCE OUTLINE

I. Types of Computers
  A. Dedicated **(Transparency CA1-1)**
    1. Definition—special-purpose computer
    2. Examples
      a. digital clock
        (1) special function keys—set, mode, computer, timer
        (2) liquid crystal readout
      b. digital microwave
        (1) special function keys—timer, set, clock, heat sensors
        (2) LED readout
      c. digital automobile readouts
        (1) sensor inputs—RPM, speed, clock, fuel temperature, pressure
        (2) LED readouts, liquid crystal
        (3) controller switch and values
      d. digital television tuner
        (1) special function keys—numeric pad, control switches
        (2) LED readouts, liquid crystal, CRT
      e. digital computer game
        (1) special function keys, joysticks, mouse, sensor, padels, pad (digitizer)
        (2) CRT, LED, sound
      f. digital meters
        (1) special function keys, sensors
        (2) LED, liquid crystal
  B. Nondedicated **(Transparency CA1-2)**
    1. Definition—general-purpose computer
    2. Examples
      a. home microcomputer (personal computer—PC)
        (1) typewriter keyboard
        (2) CRT, printers
        (3) can run many different kinds of software
        (4) can be programmed usually in one computer language (most common is BASIC)
      b. office microcomputer
        (1) typewriter keyboard, numeric key pad, and special function keys
        (2) CRT, printers, plotters
        (3) can run many different kinds of software
        (4) can be programmed in several different computer languages
        (5) usually has extra memory included

C. Computer Architecture
  1. Special functions (always dedicated)—key that allows you to perform special operations on the computer.
  2. Main frame—a large computer.
  3. Microcomputer—a computing system with a processor and sufficient memory to allow input and output operations.
  4. PC—personal computer.
  5. Minicomputer—a computer that is between a microcomputer and a main frame in size.
  6. Digital—a system in which the variables are represented by digits.
  7. Analog—a system that has a continuous dependence on another.
  8. Data representation (8 or 16 bit)—the amount of information capacity on a system.

C. Peripherals **(Transparency CA1-3)**
  1. Common
    a. printer—a device used to output in hardcopy.
    b. modem—a device used to translate the signals of a computer to the signals of a telephone network.
    c. sound generator—a device used to convert the signals in a computer to sound.
  2. Special functions
    a. plotter—a device used to convert signals in the computer to graphic form.
    b. cold typesetter—a device used to set type.
    c. photoprinter—a device used to print negatives and photographs through a computer.
    d. sensory devices—a measuring or controlling device that changes one type of energy into another.
    e. CNC—computer numerical control.
    f. robot—programmable, multifunction manipulator designed to move material, parts, tools, or special devices through variable programmed motions for the performance of a variety of tasks.
    g. uniform product code—identification system for products.

II. Operation and Care
  A. Computers need to be protected from dust when not in use.
  B. If diskettes are not being used, they should be stored in a safe place, well away from any magnetic sources. **(Transparency CA1-4)**
  C. Most computer peripherals have the potential for overheating: do not let these devices become too hot.
  D. Static can damage computers and storage media (tapes, diskettes): "zapping" this equipment with static should be avoided.
  E. Do not disconnect peripherals or cartridges while the computer is running—you might damage your equipment beyond repair. Computers need to be protected from electrical surges. If you hear thunder or have reason to believe a power interruption may occur, you should turn off your computer immediately.

III. Input Peripherals
  A. Keyboard
    1. typewriter—keys on the computer that resemble those on a typewriter.
    2. numeric key pad—a set of special keys used for quick numeric calculations.
    3. special function keys
      a. control—keys that allow you to perform basic control operations.
      b. escape—key that allows you to escape out of the computer program.
      c. left and right arrows—keys that allow you to move left or right without affecting what has been entered.
  B. Digitizer
    1. tablet/pad—a device used to change signals in the computer to graphic outputs.

        2. mouse/joystick—a hand-operated device used to translate signals in the computer to perform special operations.
        3. analog to digital converter—a device that converts analog signals in the computer to digital signals.
    C. Others
        1. cameras
        2. sensors

IV. CPU
    A. CPU chip
        1. read
        2. write
        3. calculate
        4. decide
    B. RAM (Random Access Memory)—This is the main memory of a computer that is accessible to the user. (For example, when you type your name on the computer's keyboard, the characters of your name are stored in RAM.) The data stored in RAM can be changed or retrieved with lightning speed, but will also be lost when the computer is turned off (unless transferred to secondary or auxiliary storage).
    C. ROM (Read Only Memory)—This is storage of information or data that cannot be changed by the user and is used when the computer is turned on. Information in ROM is usually built into the computer by the manufacturer, and is where, for example, a language such as BASIC is stored.
    D. CRT—a television monitor used to display output from the computer.
    E. Expansion card—a device used to expand the memory in the computer.

V. Output Peripherals
    A. Storage
        1. cassette
        2. floppy disk
        3. hard disk
    B. Hardcopy
        1. printer
        2. plotter

MATERIALS FOR STUDENTS

- Computer
- Peripherals
- Software packages
- Vocabulary Worksheet

SUGGESTED STUDENT ACTIVITIES

Use the appropriate computer program in Appendix A or other software package.

1. Have students type their names and addresses into the computer to generate a student roll.
2. Have students input their age in years to the computer, and have the computer respond with the student's age in days (or hours and minutes).
3. Have students perform English to metric conversions (example: converting their weight in pounds to weight in kilograms).
4. Have students prepare a technical report on ways to protect the computer from static electricity (electrical surges, magnetic fields, telephone, dust, overheating, etc.).
5. Have the class discuss activities that could be more easily performed with help from the computer (especially relating to business).

6. Have students prepare a list of dedicated computers used in the home and community.
7. Have students prepare a list of nondedicated computers used in the home and community.

Vocabulary Worksheet

1. peripherals
2. microcomputer
3. function keys
4. dedicated computers
5. nondedicated computer
6. main frame
7. minicomputer
8. personal computer
9. digital
10. analog
11. printer
12. backup
13. sound generator
14. hardware
15. software
16. inputs
17. outputs
18. I/O
19. CPU

TEST

Unit 1: Introduction to Computer Applications

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: __C__ 21. The class you are now attending is—
A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. Making a duplicate copy of records for storage in case of emergency is called—
A. record keeping
B. backup
C. mass storage
D. networking

___ 2. A special-purpose computer is called—
A. dedicated
B. nondedicated
C. person computer
D. main frame

___ 3. A general-purpose computer is called—
A. dedicated
B. nondedicated
C. personal computer
D. main frame

___ 4. A system in which the variables are represented by digits is—
A. analog
B. data representation
C. PC
D. digital

___ 5. A computer which is between a microcomputer and a main frame is a—
A. digital
B. analog
C. minicomputer
D. special function

___ 6. A device used to translate the signals of a computer to the signals of a telephone network is a—
A. modem
B. printer
C. plotter
D. sound generator

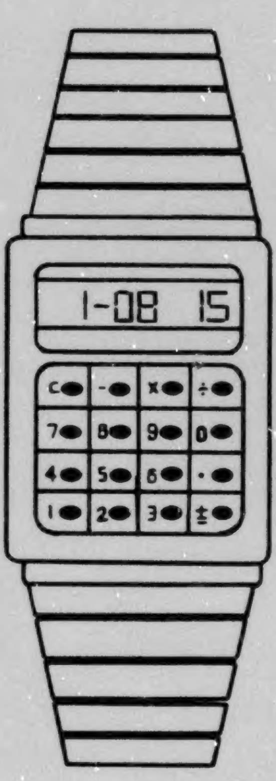
___ 7. A device used to convert signals in the computer to graphic form is a—
A. printer
B. plotter
C. modem
D. cold typesetter

___ 8. A programmable, multifunction manipulator designed to move material, parts, tools, or special devices through variable programmed motions for the performance of tasks is a—
A. plotter
B. photoprinter
C. CNC
D. robot

___ 9. A measuring or controlling device that changes one type of energy into another is a—
A. sensory device
B. CNC
C. CAD
D. CAM

___10. An identification code for products is a—
A. CNC
B. uniform product code
C. CAD
D. CAM

DEDICATED COMPUTERS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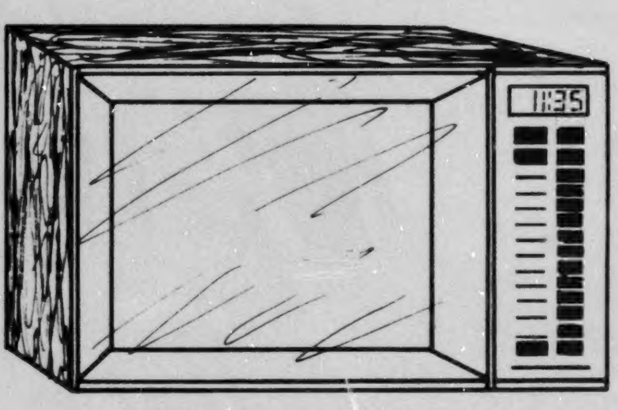
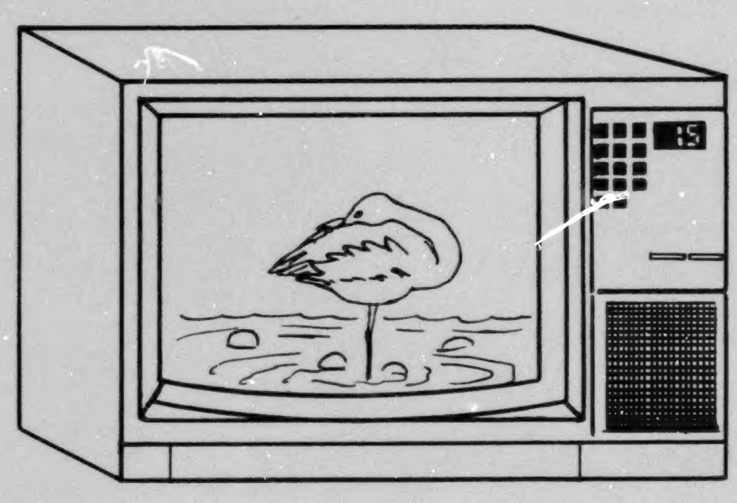
DIGITAL WRIST WATCH
WITH SPECIAL BUTTONS
OR KEYS

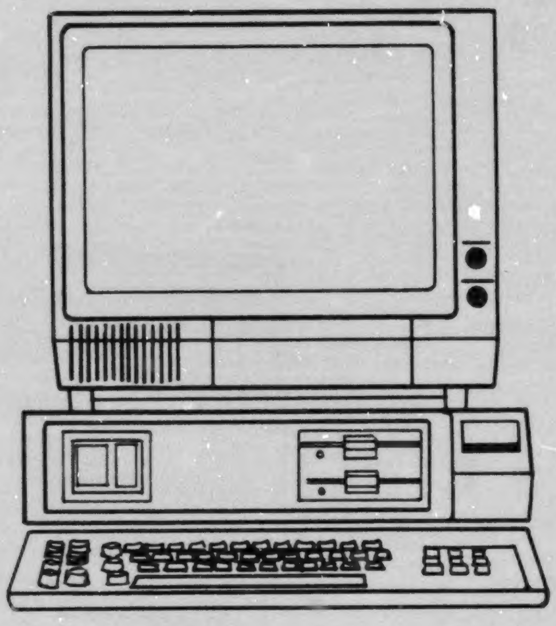


MICROWAVE OVEN
WITH DIGITAL
CONTROLS

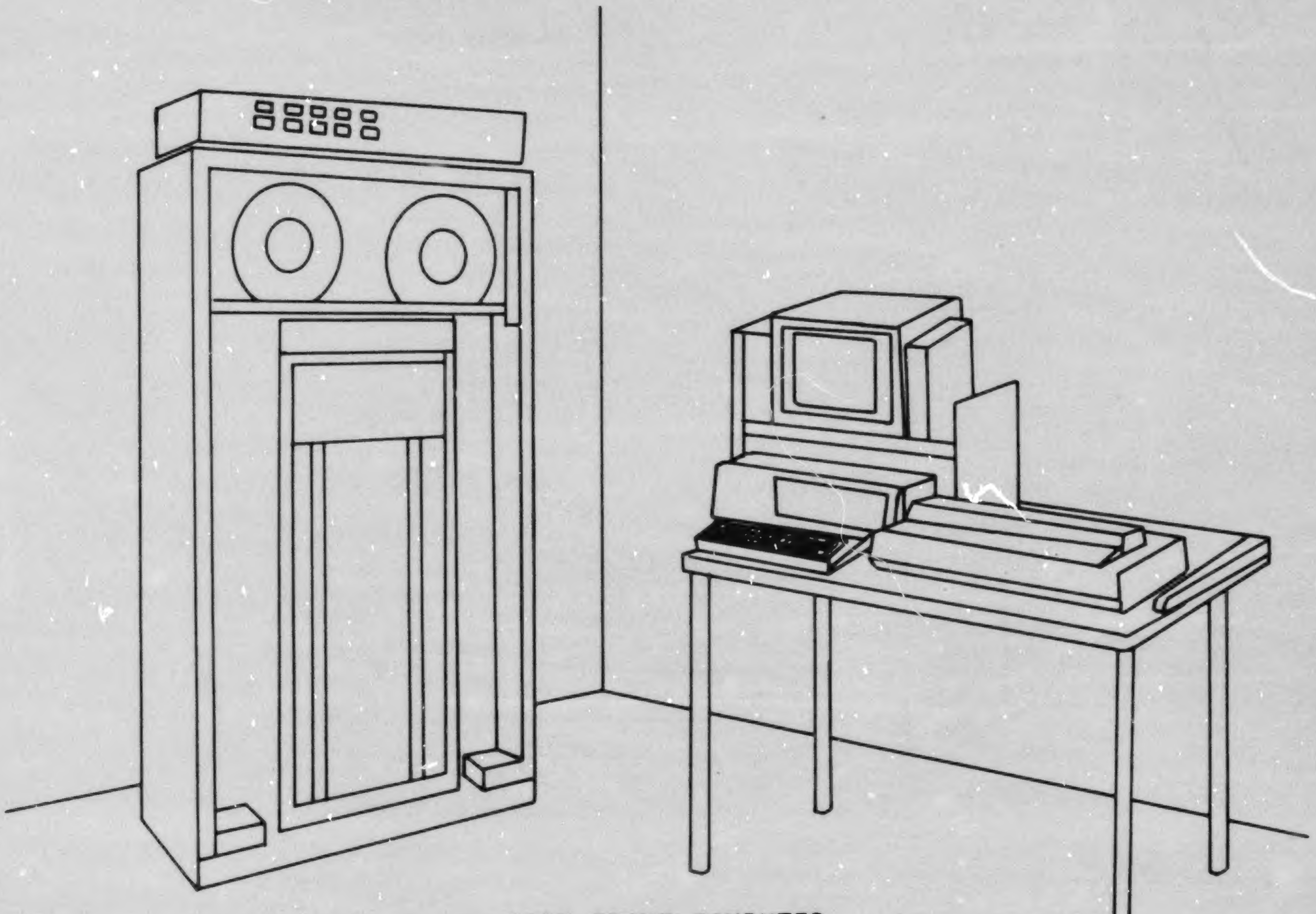


DIGITAL TELEVISION
CONTROL

NONDEDICATED COMPUTERS

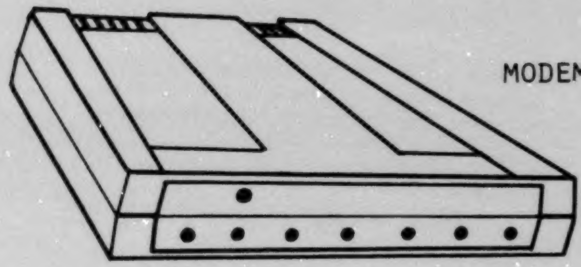


MICROCOMPUTER



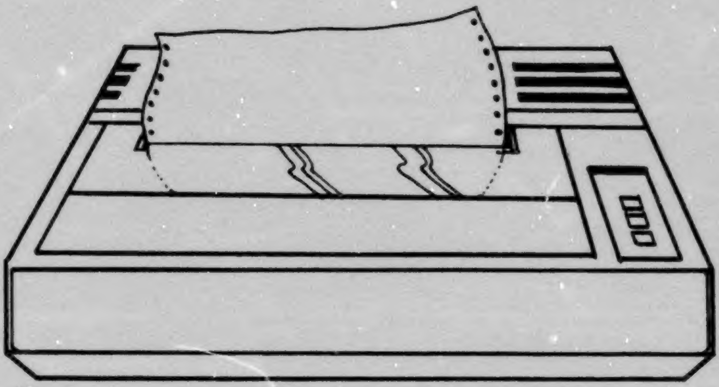
MAIN FRAME COMPUTER

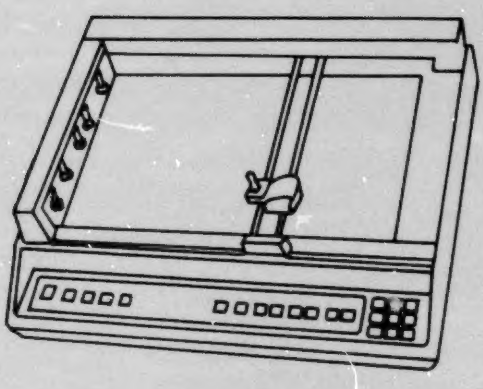
PERIPHERALS



MODEM

PRINTER





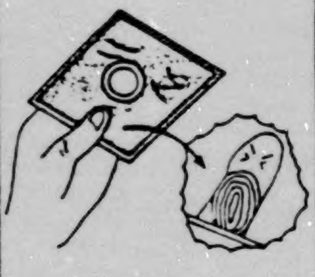
PLOTTER

CA1-3

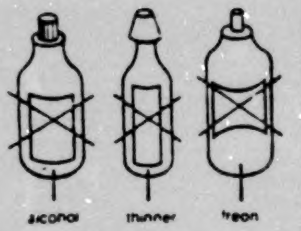
BEST COPY AVAILABLE

CARE OF DISKETTES

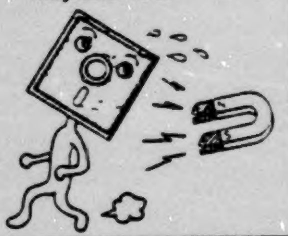
1. Do not touch disk surface. It is easily-contaminated, which causes errors.



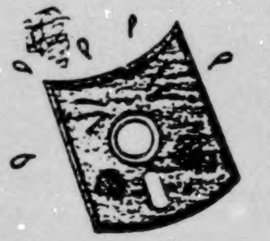
2. Do not use alcohol thinners or freon to clean disk.



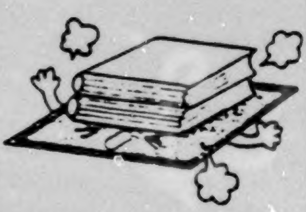
3. Do not use magnets or magnetized objects near the disk. Data can be lost from a disk exposed to a magnetic field.



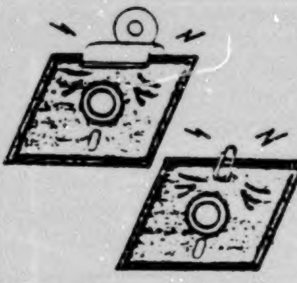
4. Do not bend or fold the disk.



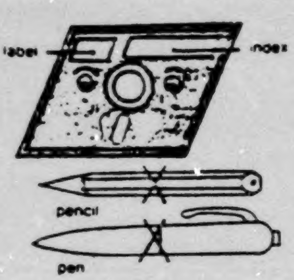
5. Do not place heavy objects on the disk.



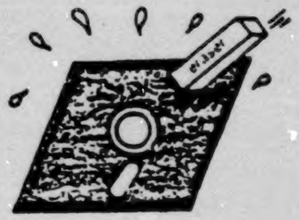
6. Do not use rubber bands or paper clips on the disk.



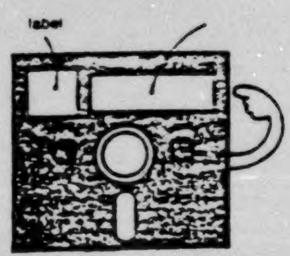
7. Do not write on disk label with pencil or ball-point pen. Use felt-tip pen only.



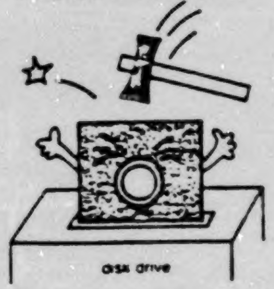
8. Do not use erasers on disk.



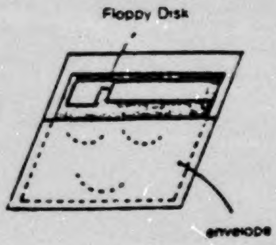
9. Apply index label to the right of our label. Do not use labels in layers.



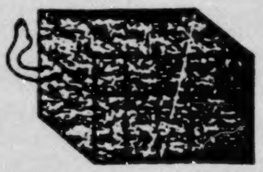
10. Insert carefully, by grasping upper edge and placing it into the drive.



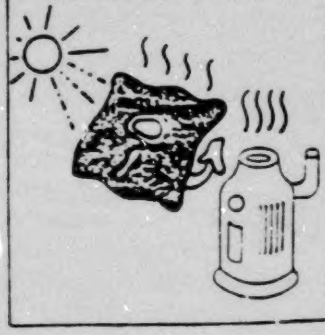
11. Keep disk in its protective envelope when not in use.



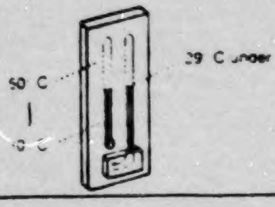
12. Disks not being used should be stored vertically in their box.



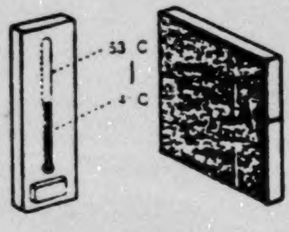
13. Do not expose the disk to excessive heat or sunlight.



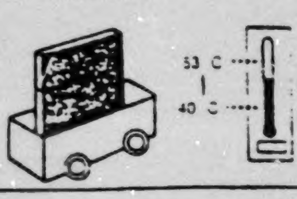
14. Operating environment:
    - A. Temperature 10°C to 50°C (50°F to 122°F)
    - B. Wet Bulb Temperature: Less than 29°C
    - C. Relative Humidity: 20% to 80%



15. Storage environment:
    - A. Temperature: 4°C to 53°C (40°F to 127°F)
    - B. Relative Humidity: 8% to 80%)



16. While in transit the disk should be in its envelope in a protective box within the following ranges:
    - A. Temperature: -40°C to 53°C (-40°F to 127°F)
    - B. Relative Humidity: 8% to 90%



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2

Industrial Computer Applications

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. identify industrial computer applications;
2. identify management information systems;
3. identify computer communication methods; and
4. identify automated production systems.

KEY WORDS: VOCABULARY

The words below may be new to students studying computer applications. Teachers should help students understand these words as they are used in this topic of study.

computer-assisted engineering
absolute
relative
polar
2D
3D

work envelope
problem solving
flow charting
coding
PERT charting

TEACHING AIDS

- Appendices A and B
- Overhead projector
- Film or slide/tape presentation
- Test Key: 1-B, 2-C, 3-B, 4-D, 5-D, 6-B, 7-A, 8-D, 9-C, 10-B
- Transparencies: You will find transparencies CA2-1 through CA2-6 at the end of this unit. If you wish, these handouts may be duplicated in quantity and given as handouts to students while they are studying different aspects of this unit.
  CA2-1: Coordinate Systems
  CA2-2: Work Envelope
  CA2-3: Management Information Systems
  CA2-4: Communications
  CA2-5: Computer-Assisted Drafting
  CA2-6: Automated Production Systems

SUGGESTED REFERENCES

Bame, E. A., and Cummings, P. Exploring Technology. Worcester, Mass.: Davis Publications, 1980.

Covvey, H. D., and McAlister, N. H. Computer Consciousness: Surviving the Automated Eighties. Reading, Mass.: Addison-Wesley Publishing, 1980.

Glenhill, B. X. Discovering Computers. Chicago, Ill.: Science Research Associates, 1981.

Heiner, C. W., and Hendrix, W. R. People Create Technology. Worcester, Mass.: Davis Publications, 1980.

Karp, H. R., ed. Basics of Data Communications. New York: McGraw-Hill, 1976.

Kruglinski, D. Data Base Management Systems: A Guide to Microcomputer Software. Berkeley, Calif.: Osborne/McGraw-Hill, 1980.

McMullen, B. E., and McMullen, J. F. Microcomputer Communications. New York: Wiley Press, 1982.

Marsh, K. The Way the New Technology Works. New York: Simon and Schuster, 1982.

Martin, J. Telecommunications and the Computer. 2nd ed. Englewood Cliffs, N.J.: Prentice-Hall, 1976.
Wood, M. Computer Awareness. Cincinnati: South-Western Publishing, 1982.
Zinsser, W. Writing with a Word Processor. New York: Harper and Row, 1983.

SENTENCE OUTLINE

- I. CAE
  - A. CAE (computer-assisted engineering) refers to the entire computer-controlled system of industry.
  - B. Geometric principles
    - 1. Coordinate systems **(Transparency CA2-1)**
      - a. Cartesian—this system allows movement along three axes: x, y, and z.
      - b. Cylindrical—this system moves the work envelope in the outline of a cylinder.
      - c. Polar—this system moves the work envelope in the outline of a sphere.
      - d. Revolute—this system moves the work envelope in a four-axes anthropomorphic motion, yielding up to six degrees of motion in the shoulder, elbow, and wrist.
      - e. 2D—this system allows graphics to be produced in two dimensions.
      - f. 3D—this system allows graphics to be produced in three dimensions.
    - 2. Work envelopes/space **(Transparency CA2-2)**
      - a. limits—the total amount of work space, called the work envelope.
      - b. full size—signals in the computer read and output in full size. Scales must be specified in the computer program, as desired.
  - C. Problem solving
    - 1. defining the task—what exactly is the problem
    - 2. planning the solution—looking at all the alternatives
    - 3. flow charting/PERT charting—graphically charting the solution
    - 4. coding—writing out steps to follow
    - 5. check solution—pilot test solution
    - 6. documentation—recording results
- II. Selected Applications
  - A. Management information systems (MIS) **(Transparency CA2-3)**
    - 1. record keeping
    - 2. personnel system
    - 3. energy monitoring
    - 4. CAI
    - 5. simulation modeling
  - B. Communications **(Transparency CA2-4)**
    - 1. cold typesetting
    - 2. photoprinting
    - 3. direct mail
    - 4. bulletin board
    - 5. modem
    - 6. simulation modeling
  - C. Computer-assisted drafting (CAD) **(Transparency CA2-5)**
    - 1. planning
    - 2. designing
    - 3. drafting
    - 4. engineering
    - 5. simulation modeling
  - D. Automated production systems **(Transparency CA2-6)**
    - 1. CAM
    - 2. plant layout
    - 3. inventory

4. robotics
5. CNC
6. quality control
7. simulation modeling

MATERIALS FOR STUDENTS

- Appendices A and B
- Software package
- Vocabulary Worksheet

Vocabulary Worksheet

1. computer-assisted engineering
2. absolute
3. relative
4. polar
5. 2D
6. 3D
7. work envelope
8. problem solving
9. flow charting
10. coding
11. PERT charting

TEST

Unit 2: Industrial Computer Applications

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: __C__ 21. The class you are in is—
A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. This coordinate system allows movement along three axes: x, y, and z.
A. Cartesian
B. polar
C. cylindrical
D. revolute

___ 2. This coordinate system moves the work envelope in the outline of a cylinder:
A. Cartesian
B. polar
C. cylindrical
D. revolute

___ 3. This coordinate system moves the work envelope in the outline of a sphere:
A. Cartesian
B. polar
C. cylindrical
D. revolute

___ 4. This coordinate system moves the work envelope in a four-axes anthropomorphic motion, yielding up to six degrees of motion in the shoulder, elbow, and wrist:
A. Cartesian
B. polar
C. cylindrical
D. revolute

___ 5. It is the total amount of work space:
A. full size
B. 2D
C. 3D
D. work envelope

___ 6. Which of the following operations is considered a management function?
A. photoprinting
B. record keeping
C. quality control
D. engineering

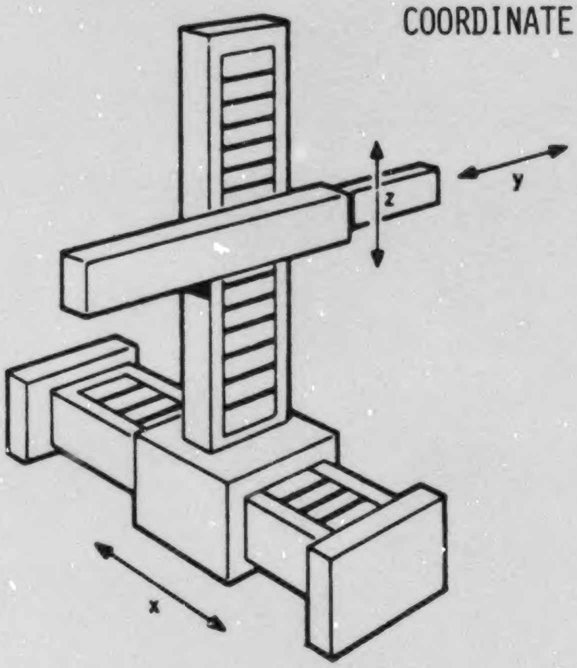
___ 7. Which of the following operations is considered a communications operation?
A. photoprinting
B. record keeping
C. quality control
D. engineering

___ 8. Which of the following operations is considered a computer-assisted design operation?
A. photoprinting
B. record keeping
C. quality control
D. engineering

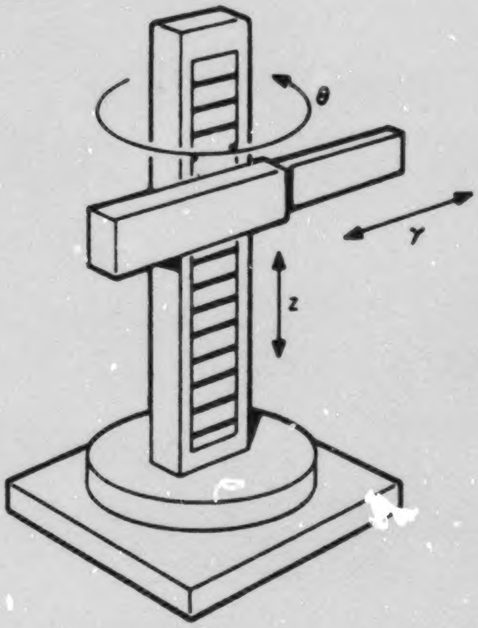
___ 9. Which of the following operations is considered an automated production systems operation?
A. photoprinting
B. record keeping
C. quality control
D. engineering

___10. This refers to the entire computer-controlled system of industry:
A. CAD
B. CAE
C. CNC
D. CAM

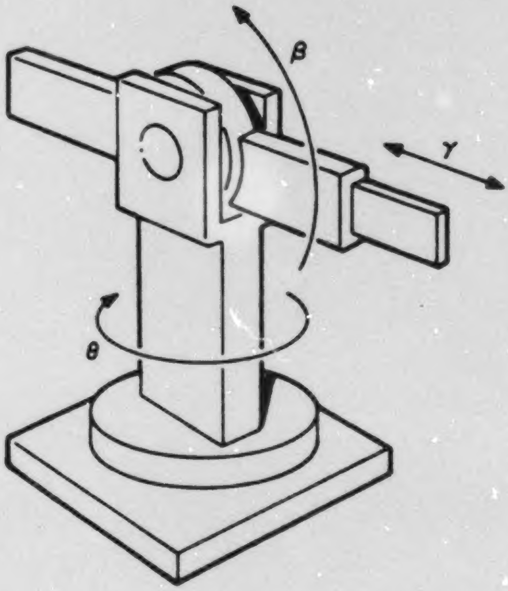
COORDINATE SYSTEMS



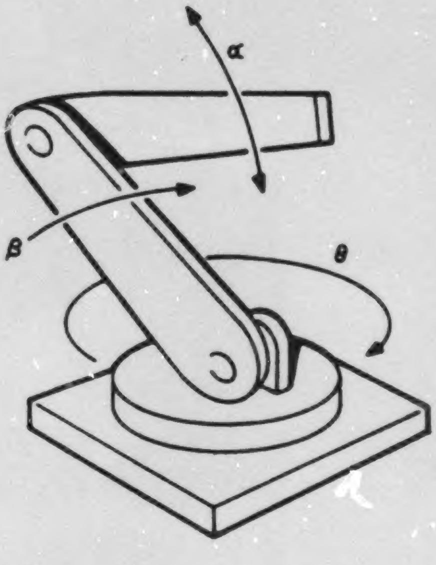
CARTESIAN COORDINATES



CYLINDRICAL COORDINATES

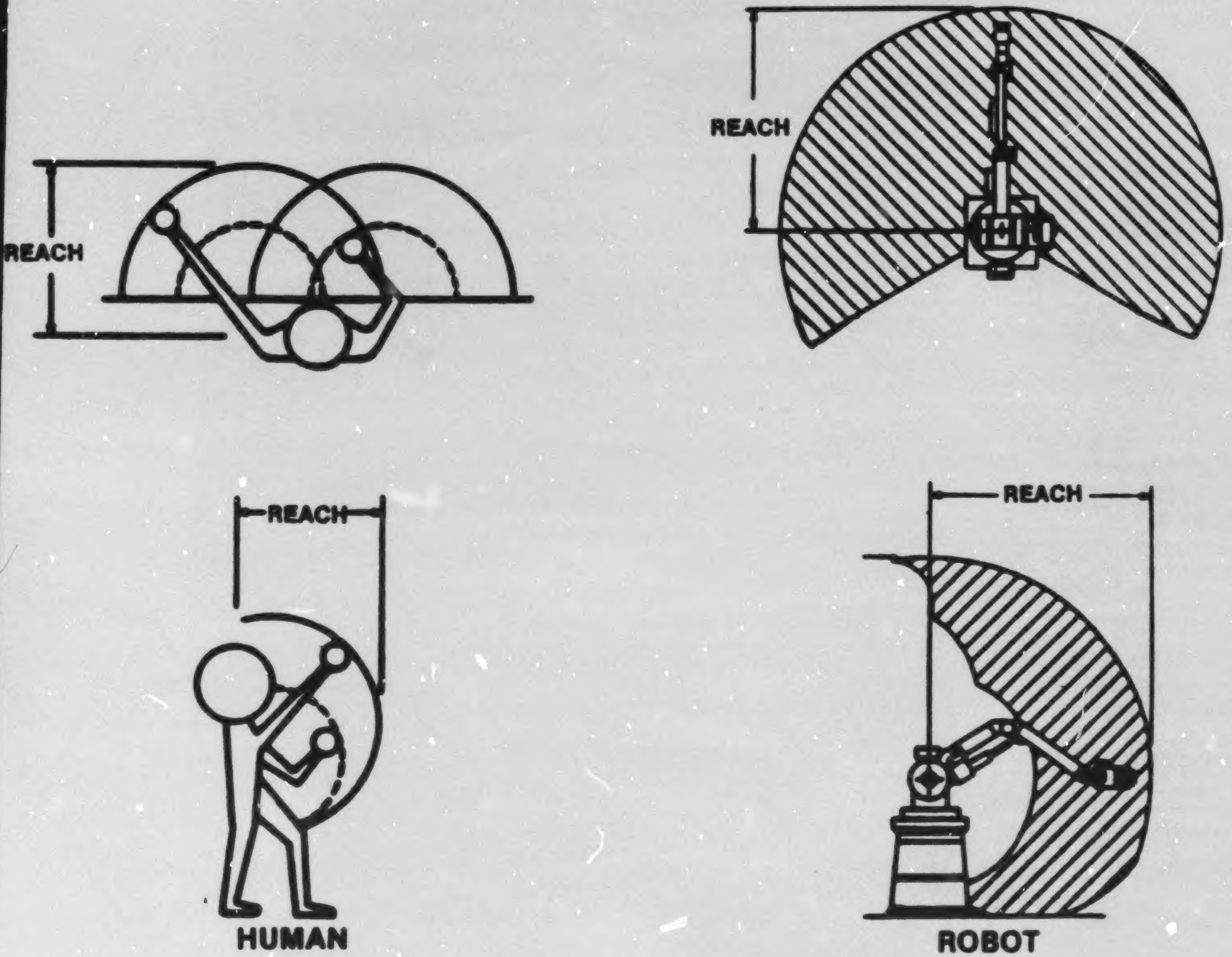


POLAR COORDINATES



REVOLUTE COORDINATES

WORK ENVELOPE


REACH
REACH
REACH
REACH
HUMAN
ROBOT

(Courtesy Robot Systems, Inc., Norcross, GA)

MANAGEMENT INFORMATION SYSTEMS

1. Record Keeping
2. Personnel System
3. Energy Monitoring
4. CAI
5. Simulation Modeling

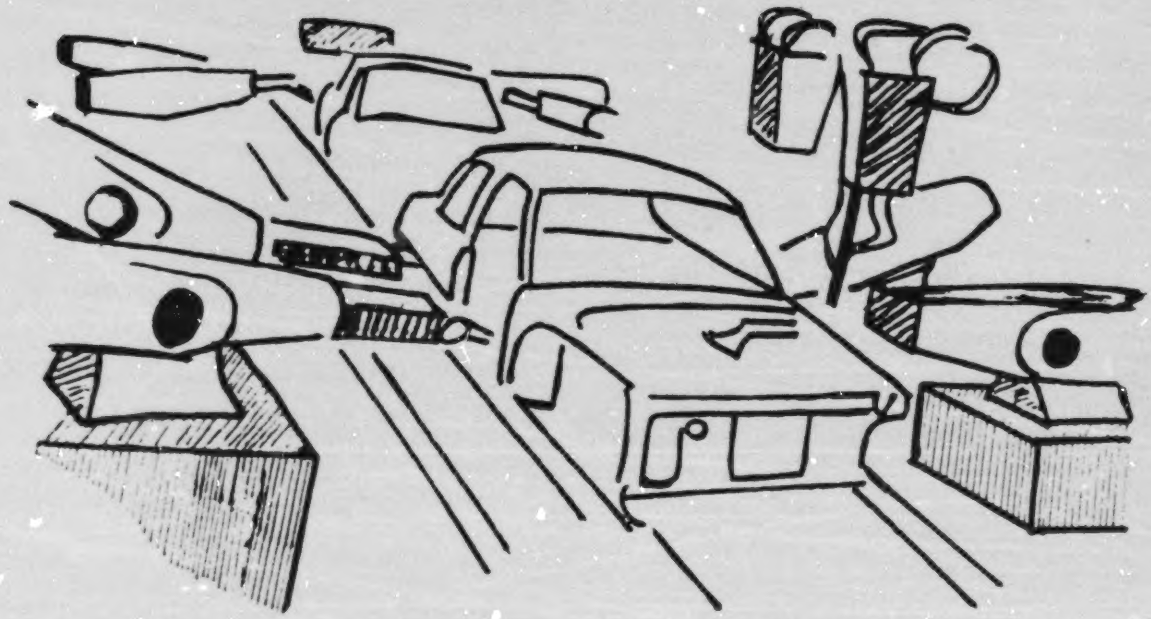
COMMUNICATIONS

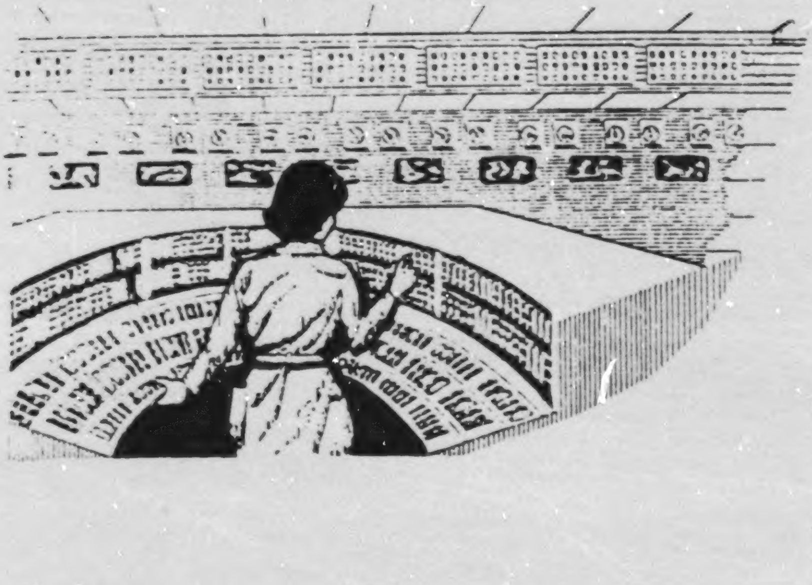
1. Cold Typesetting
2. Photoprinting
3. Direct Mail
4. Bulletin Board
5. Modem
6. Simulation Modeling

COMPUTER-ASSISTED DRAFTING

1. Planning
2. Designing
3. Drafting
4. Engineering
5. Simulation Modeling

AUTOMATED PRODUCTION SYSTEMS





3

Management Information Systems

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. define the term **data management** adequately;
2. use the computer to keep records;
3. use the computer to manage people and activities;
4. use the computer to monitor the use of energy; and
5. use the computer as a tool for learning.

KEY WORDS: VOCABULARY

The words below may be new to students studying computer applications. Teachers should help students understand these words as they are used in this topic of study.

management information systems
record keeping
inventory
scheduling
routing
data storage
data retrieval
computer-assisted instruction

data processing
distributed data processing
demand report
electronic mail
exception report
prediction report
telecommunications
uniform product code
electronic funds transfer

TEACHING AIDS

- Spread sheet software package
- Home management software package
- Audiovisual pens
- Magazines
- Newspaper clippings
- Computer
- Films and/or slide series
- Test Key: 1-B, 2-A, 3-C, 4-D, 5-B, 6-C, 7-A, 8-B, 9-C, 10-B, 11-A, 12-C, 13-D, 14-B, 15-C, 16-D, 17-C, 18-A
- Transparencies: You will find transparencies CA3-1 through CA3-7 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to students while they are studying different aspects of this unit.
  CA3-1: Management Information Systems
  CA3-2: Data Management Record Keeping
  CA3-3: An Inventory Control System
  CA3-4: Using Computers to Manage Communications
  CA3-5: Uniform Product Code
  CA3-6: Using Computers to Monitor the Use of Energy
  CA3-7: Computer-Assisted Instruction

SUGGESTED REFERENCES

Coulson, J. A., ed. Programmed Learning and Computer-based Instruction. New York: John Wiley and Sons, 1962.

Covvey, H. D., and McAlister, N. H. Computer Consciousness: Surviving the Automated Eighties. Reading, Mass.: Addison-Wesley Publishing, 1980.
Glenhill, B. X. Discovering Computers. Chicago: Science Research Associates, 1981.
Graham, Neill. The Mind Tool Computers and Their Impact on Society. New York: West Publishing Co., 1983.
Heiner, C. W., and Hendrix, W. R. People Create Technology. Worcester, Mass.: Davis Publications, 1980.
Karp, H. R., ed. Basics of Data Communications. New York: McGraw-Hill, 1976.
Kruglinski, D. Data Base Management Systems: A Guide to Microcomputer Software. Berkeley, Calif.: Osborne/McGraw-Hill, 1980.
McMullen, B. E., and McMullen, J. F. Microcomputer Communications. New York: Wiley Press, 1982.
Marsh, K. The Way the New Technology Works. New York: Simon and Schuster, 1982.
Martin, J. Telecommunications and the Computer. 2nd ed. Englewood Cliffs, N.J.: Prentice-Hall, 1976.
Simondi, T. What If/A Guide to Computer Modeling. Los Angeles, Calif.: Book Company, 1982.
Wood, M. Computer Awareness. Cincinnati: South-Western Publishing, 1982.
Zinsser, W. Writing with a Word Processor. New York: Harper and Row, 1982.

SENTENCE OUTLINE

I. What Are Management Information Systems? **(Transparency CA3-1)**
  A. Management information systems (MIS) are systems responsible for getting the right information to the right people.
  B. Business data processing and distributed data processing are used to process orders, payments, and other company files.
    1. Data processing refers to a company's files being centrally located.
    2. Distributed data processing refers to each branch of a company keeping their own records.
  C. MIS involves schedule listings, demand reports, exception reports, and prediction reports.
    1. Schedule listings are weekly prints distributed to those employees needing certain information.
    2. Demand reports provide managers with specific information.
    3. Exception reports contain information that needs to be brought to human attention—delinquent accounts.
    4. Prediction reports are used to predict future trends based on given data.
  D. Office automation plays a big part in MIS.
    1. Word processing units have replaced typewriters.
    2. Telecommunication systems have speeded up communications.
    3. Electronic mail has led to a higher efficiency of company operation.
    4. The uniform product code has replaced the traditional cash register.
    5. Electronic fund transfers have revolutionized the way companies handle money.

II. Using the Computer to Keep Records
  A. Companies can be used to keep many operations and management records.
  B. Data management record keeping consists of: **(Transparency CA3-2)**
    1. billing
    2. accounting
    3. payroll
    4. inventorying
    5. personnel data information
    6. scheduling/routing
    7. reporting

C. Before computers were available, businesses kept records on paper and stored them in bulky cabinets. Keeping records on computers has three advantages.
  1. Computers can store information much more efficiently and take up less space than paper records stored in filing cabinets.
  2. Computers can retrieve stored data much faster than the information could be looked up on paper.
  3. Duplicate copies of records can easily and quickly be made. This enables businesses to store backup or duplicate copies of their important records in safe places, in case of fire or theft.

D. The management of personnel is a task requiring much record keeping. A computer can handle all parts of the personnel system with efficiency and speed.

E. The computer can be programmed to calculate all employee wages, overtime, deductions, and benefits. By using a printer, employee checks can be printed, signed, and mailed to employees.

F. Management can use summaries of employee records to determine whether employee time is being used efficiently. Such personnel summaries can be used to plan schedules, clarify disputes over who is responsible for what, and help in placement of individuals within an industry or business.

G. Material and supply management
  1. Inventory (**Transparency CA3-3**)
    a. An inventory is a record of all available supplies, raw materials, and finished products currently being stored by a business.
    b. Computers can be used to run a more efficient, faster, and better controlled inventory.
    c. A typical inventory control system has five steps.
      (1) Production managers and warehouse managers turn in weekly or monthly inventory to data processors for entry on a CRT terminal or keypunch machine.
      (2) The data processors enter and check data, and inform computer operators that a new inventory listing is needed.
      (3) The computer operators run a weekly or monthly inventory control report, which is turned in to the order manager.
      (4) The order manager checks the inventory control report to see if it balances with their records. Possible shortages are noted and reordered, prepared, and phoned or mailed in.
      (5) New deliveries of raw materials and supplies are delivered to the warehouse manager. The invoices detailing the deliveries are sent to the order manager.
  2. Bill of materials
    a. Invoicing and billing are crucial parts of running a business. Before computers, all such records were kept on paper.
    b. Computers use a master customer list, a master price list, and a products available list to print invoices and bill customers.
    c. The master customer list has a set of records for each customer. Such a record might consist of customer number, customer name and address, type of account, current charges, and amount owed to the company.
    d. The master price list has a list of all products the company produces. Each product has a price, and some products may have more than one price.
    e. The products available list tells which finished products are available for delivery to customers.
    f. Using the three lists or files, the computer prints the invoices. Invoices can be one of two types.
      (1) Blank invoices have only customer number, name, and address. These invoices are filled out when delivery is made.

(2) Preordered invoices have the same information as blank invoices, but also list the exact number of each product the customer wants delivered.

g. Billing is usually done at the end of the month. The computer adds the cost of all products the customer ordered for the month, using information from the invoices, and prints the bills.

3. Scheduling
   a. Scheduling is a technique for getting maximum production by using all parts of a business as efficiently as possible.
   b. Three types of scheduling are useful in business: workshift scheduling, equipment use scheduling, and power use scheduling.
      (1) Workshift scheduling is the assigning of workers to different shifts to get the best work out of them.
      (2) Equipment scheduling is planning of machine use and maintenance to get the most out of a company's equipment, while at the same time keeping the equipment in the best possible condition.
      (3) Power use scheduling is the timing of industrial use to get the least possible power use.
   c. Computers can be used to provide very efficient scheduling.
   d. Personnel can be rated for productivity and efficiency. A computer list can be generated to highlight which employees need supervision, which do not, which deserve promotions, etc.
   e. Computer programs can also be written to keep track of all equipment. Such programs might schedule maintenance checks, spot machines that need repairing or replacing, and pinpoint workers who are misusing equipment.
   f. A computer program can be used to study power in a factory. This type of program could indicate the cheapest time to operate equipment or suggest ways that industrial energy conservation can be improved.

III. Using the Computer to Manage Communications **(Transparency CA3-4)**
   A. Word processing
      1. A word processor is a small computer system consisting of a CRT, a keyboard, and a printer.
      2. Word processors have largely replaced typewriters in business.
      3. Unlike the typewriter, word processors allow editing and correction of copy before the document is actually printed.
      4. After typing the document on the keyboard, the operator uses editing functions to check spelling, do indentations, and make corrections.
      5. The editing functions let the operator delete, add, or move text within the document.
      6. Some businesses have standardized forms stored in the word processor. The operator then fills in only the necessary information.
   B. Telecommunications
      1. Telecommunications is a system that lets computers communicate with other computers using the telephone.
      2. A modem is a device that connects a computer to a telephone.
      3. Once a modem is connected to a computer, the computer is ready to receive information from another computer or send information to another computer.
      4. Using a database, a business can obtain more efficient storage because the database can be accessed by many different programs.
      5. A retrieval service uses telecommunications to load information from another computer.
      6. Such services are often called networks and can provide information to many users at the same time.
      7. The networks or retrievals services provide information like stock market quotes, local or world news, climate information, and raw material prices.

C. Electronic mail
   1. Electronic mail is a computer creating documents and sending them electronically to their destination. This can be done within a company itself, or from one company to another.
   2. Electronic mail can be sent over telephone lines, coaxial cable, or optical fiber.
   3. A mailout is a mailing of a certain document to many people at the same time.
   4. Once a standard document has been prepared for mass mailout, the programmer or operator instructs it to print the mass mailout.

D. The uniform product code has replaced the traditional cash register. **(Transparency CA3-5)**
   1. It reads a code through a scanner and transmits the code to a computer, which then sends the price and description of the item back to the terminal.
   2. The price and description are displayed on the monitor and on the customer's sales slip.
   3. The computer also updates the store's sales records.

E. Electronic funds transfer
   1. Electronic funds transfer (EFT) is a process of handling funds electronically.
   2. Companies can use electronic checks instead of conventional checking methods.
   3. More and more preauthorized payments and deposits are being used to transact business.
   4. Bank tellers use terminals to enter transactions directly into their bank's computer.
   5. Automatic teller machines provide 24-hour banking services.

IV. Using the Computer to Manage People

A. The computer provides an excellent means by which to manage people.

B. All personnel data information can be stored and retrieved easily on a computer. This includes such data items as general employee information, health and injury records, vacation and sick leave, evaluations, promotion, and retirement.

C. The computer can be used to control manpower in production areas and make shifts where necessary.

D. The computer provides the industrial technology instructor a valuable tool with which to organize, plan, control, and monitor AIASA activities.
   1. The chapter's annual plan of action can be itemized graphically.
   2. Flow charts and spreadsheets can be developed for chapter activities.
   3. Fund-raising activities can be charted on the computer.
   4. AIASA leadership development can be stored on the computer.
   5. School and community service projects can be stored on the computer.
   6. Enterprising activities can also be stored on the computer.
   7. AIASA contests and awards can be set up and recorded on the computer.

E. Laboratory activities and laboratory management can be made easier through the use of a computer.
   1. The student personnel system can be organized and run by the computer. Each class member can be logged in the computer and assigned a code which provides the student position in the organizational structure.
   2. The computer can be used to randomly assign clean-up chores to students.
   3. The computer can provide the teacher a daily planning calendar.
   4. The computer can also be used to keep student grades and records.
   5. A bulletin board program can aid the teacher in planning.
   6. The teacher can maintain a running inventory of tools, equipment, and supplies on the computer.
   7. Departmental reports can be word-processed on the computer, stored in memory, and retrieved easily.

8. The computer can be interfaced to provide the teacher a continuous flow of up-to-date information.

V. Using the Computer to Monitor the Use of Energy (**Transparency CA3-6**)
  A. The computer provides an efficient means of monitoring the use of energy.
  B. The ability to store and retrieve energy data at a faster rate and in more detail provides a mode for the wiser use of energy.
  C. Computers can be used to generate, convert, and control mechanical, electrical, and pneumatic-hydraulic power.
  D. Computers can be used to collect and analyze data.
  E. The use of instrumentation with computers can monitor data-based systems.
  F. Computers can be used to develop and interpret maps, charts, and schedules.
  G. Computers can be used to monitor the weather and more accurately report it.
  H. Computers can be used in the home to conserve energy.
    1. Computer-operated thermostats control heating and cooling systems more efficiently.
    2. Home appliances are now controlled by computers to maximize their efficiency.
    3. Electric and water use can be monitored and controlled by logging usage information in the computer.
  I. Computers are used every day to monitor transportation.
    1. Computerized traffic-control systems control traffic problems through the use of sensing devices.
    2. Builders of roads and highways use CAD systems to design more transportation networks.
    3. Computerized systems in automobiles provide useful information and warning signals to the operator.
    4. Transportation scheduling is monitored through the use of computers.
    5. Some mass transit systems are totally controlled and monitored by a computer system.
    6. Air traffic control is totally computerized, thus eliminating serious accidents.
    7. Computer-controlled satellites are used to monitor communication systems and our defense.
    8. Future space manufacturing and construction installations will be operated and controlled by computers.

VI. Computer-Assisted Instruction (**Transparency CA3-7**)
  A. Computer-assisted instruction (CAI) is the use of special teaching programs on computers.
    1. The program teaches by showing the student information about a subject, then asking the student a series of questions about that information.
    2. If a student answers the questions incorrectly, he/she is sent back to revise the information. If the questions are answered correctly, the student is shown more information.
    3. Thus, a student learns the information at his or her own pace, and such programs are often called "self-paced" courses.
  B. Since CAI programs require a lot of input from the student, great care must be taken in their design so as to make the program "friendly" to those who use it. Programs that efficiently guide the user through input are called "user-friendly" programs.
  C. A CAI program can appeal to a wide variety of students by offering different levels of difficulty. A beginner can start at the beginning, a more knowledgeable student could start in the middle, and an expert might start close to the end.
  D. Many of the programs written for CAI involve subjects that require a lot of drill and practice.
    1. Because most computers have limited memory, CAI programs usually cover only the most basic material.

2. CAI programs for complex subjects are difficult to write—there is more information than can be easily written into one program. The standard method for overcoming this problem is to write the CAI in units, each of which is a separate program.
3. Several types of subject material require repetition and practice to master their basic elements.
    a. spelling and rules of grammar
    b. basic arithmetic
    c. foreign languages
4. In teaching such repetitive subjects, an instructor can easily make mistakes. If the material were taught on a CAI system, these mistakes would not be made—the computer is not bored or made sleepy by endless repetition.
5. In addition, students who need special help to master a subject can be provided with more time on the computer. Also, students can be sent back to redo an earlier unit if their performance shows they have not yet mastered it.

E. Industry and business use CAI to instruct new employees on how their jobs are to be performed. Using CAI in this manner, the corporation can be sure that all employees have been taught all the procedures they need to know. Thus, CAI is especially useful in situations where every student must be taught the same process or procedure.

F. CAI has several advantages for the instructor over conventional teaching methods.
1. Cheating is eliminated or minimized. Students cannot flip through their books to find the correct answer because the answers are in the computer.
2. The CAI can be set up to use background information on each student to build learning sequences and evaluate answers.
3. The CAI can retain data about a student's learning session for use by the instructor.
4. The CAI can give students tests on the materials, score the results, and even pass the grades on to a teacher's grade-book file.

G. CAI has some disadvantages for the teacher over conventional teaching.
1. The computer is less portable than textbooks, making homework with the computer impossible. The instructor can get around this by designing text materials to operate with the computer.
2. CAI programs take a long time to write. However, when the first CAI has been written, it can then serve as a framework for future CAI programs.
3. Students are used to being taught by teachers. CAI programs should be as user-friendly as possible to make them easier for students to get used to.

VII. Simulation

A. A simulation is a program that models some real phenomenon or process. Simulation lets a programmer evaluate a process before he or she begins writing the program that will implement the process.

B. Programmers use simulation for several important reasons.
1. A programmer can discover important parts of the process that were overlooked when the project was planned.
2. A programmer can get an estimate of how long it will take to implement the new process, and how much it will cost.
3. A programmer may discover unneeded steps or other shortcuts that will make the new process easier to do.

C. Simulation can be very complex. One sophisticated use of simulation is to simulate the operation of a new computer system on an already existing computer. Writing such a simulation can take an expert programmer many weeks, but it could also save the corporation that is making the new computer a lot of money.

D. The need for simulation must be considered carefully by a project leader. While simulation can be very helpful, it also can take a very long time to write a complex simulation. Thus, if simulation is to be used, it should be started as early as possible.

E. A computer program can be used to simulate the operation of a whole business. The relationships of the various divisions of the business can be expressed in mathematical terms and placed in the computer. The comptroller can then provide a tentative budget, and the performance of the business for the next year is evaluated in seconds.

F. A **simulator** is a simulation where the environment around the student is the same as it will be in the job he or she is being trained to do.
   1. In a flight simulator, the student observes the same instruments and view from the cockpit that he or she would have in flying the actual airplane. The computer monitors the student's actions and changes the instrument reading and cockpit view to account for them.
   2. A simulator is cost effective for an industry when the cost of the simulator is less than the cost of the machine the students are being trained to use.
      a. aircraft pilots
      b. ship pilots and navigators
      c. power plant technicians and watchstanders
      d. astronaut training

MATERIALS FOR STUDENTS

- Vocabulary Worksheet
- Student activities
- Computer programs

SUGGESTED STUDENT ACTIVITIES

Use appropriate computer program in Appendix A or other software package.

1. Have the class keep grades on the computer (with strict security control by the teacher).
2. Assign work tasks in the class by using a computer schedule.
3. Use the roll generated in Unit 1 to keep track of absenteeism on the computer.
4. Have students establish a manual inventory control system. Then have the students perform the same task on the computer and compare the two systems. Why is the computer method the better one?
5. Have students design a computer program that asks for details about a given project and returns the amount of materials needed and the cost of the project.
6. Use students in group projects, and have the groups communicate with each other using standard progress reports. Keep the reports updated, and have the groups evaluate each other's reports.
7. Have students bring clippings to class about different kinds of information available from computer networks.
8. Have students design safety procedures to be followed for different activities, and have them design computer programs that take them through a checklist before beginning major projects.
9. Have students build an interface for a simple light fixture and write a program to turn the light on and off on a set schedule.
10. Have students construct an interface for the computer to hook up to a "weather station." This would require temperature and pressure sensors. Monitor the reading from the station at set times of day, and write a program to analyze the raw data over a period of several weeks.
11. Write a computer program that simulates the monitoring process. Such a program might give an operator a couple of readings and ask for an action to be performed. Success could be measured by keeping the "system" running.

12. Attach a speech synthesizer to your computer (may be bought in kits or ready-made). Use the speech synthesizer to write a program that responds to the inputting of a number at the keyboard by speaking a name and "price" associated with that number.
13. Have the students make up their own simple CAI programs. Test the program on students who haven't designed it. What types of graphics can the students use to make the program look good? How will a correct answer be rewarded (sound, perhaps)?
14. Have the students put part of this manual on computer as a CAI. Have them design their own questions to test the user's knowledge.
15. Have the students design a simple program to simulate the rise and fall of a stock or commodity. Assume the students have a set quantity of the stock or commodity, and have the program tell them their profit or loss based on a rise or fall in price.
16. Have the students design a simple program to imitate a flight simulator. A few instruments (air speed, altitude), a simple view from the cockpit, and a joystick to control movement will be needed.

Vocabulary Worksheet

1. management information systems
2. record keeping
3. inventory
4. scheduling
5. routing
6. data storage
7. data retrieval
8. computer-assisted instruction
9. data processing
10. distributed data processing
11. demand report
12. electronic mail
13. exception report
14. prediction report
15. telecommunications
16. uniform product code
17. electronic funds transfer

TEST

Unit 3: Management Information Systems

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank provided.

Example: __C__ 21. The class you are now attending is—
A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. Making a duplicate copy of records for storage is case of emergency is called—
A. record keeping
B. backup
C. mass storage
D. networking

___ 2. In an inventory control system, the people who enter and check the data are called—
A. data processors
B. word processors
C. production managers
D. order managers

___ 3. A master customer list for a business would include a customer's—
A. age
B. sex
C. address
D. social security number

___ 4. A blank invoice contains only the customer's name, address, and—
A. bank account number
B. date
C. products ordered
D. customer number

___ 5. Most businesses send out their bills at the—
A. end of the week
B. end of the month
C. end of the business day
D. time of delivery

___ 6. Scheduling machines in a factory for maintenance is called—
A. workshift scheduling
B. power use scheduling
C. equipment use scheduling
D. maintenance listing

___ 7. A word processor is a small computer with a keyboard, a printer, and a—
A. CRT
B. disk drive
C. modem
D. cassette deck

___ 8. The main difference between a word processor and a typewriter is that—
A. a word processor has more keys
B. a word processor allows editing before printing
C. a typewriter is a little faster
D. a typewriter requires less maintenance

___ 9. A modem connects a computer to—
A. a printer
B. a CRT
C. another computer
D. a disk drive

___10. The use of telecommunication requires some control over—
A. long distance dialing
B. security
C. static
D. employee's benefits

___11. A retrieval system that uses telecommunications is called a—
A. network
B. hookup
C. cable service
D. database

___12. In some industries, computers monitor exposure of employees to—
A. disease
B. wastewater
C. contaminants
D. radiation

___13. Programs that effectively guide the user through input are called—
A. input statements
B. self-paced
C. modules
D. user-friendly

___14. An example of a subject that requires drill and practice is—
A. astronomy
B. spelling
C. physics
D. biology

___15. A simulation is a ____________________ that models some real phenomenon or process.
A. video game
B. computer language
C. computer program
D. sensor

___16. A programmer uses a simulation to tell him or her—
A. why the computer won't work
B. what time it is
C. who is using the computer
D. how long a process will take

___17. An example of a job that uses simulators for training is—
A. auto mechanic
B. programmer
C. pilot
D. doctor

___18. A simulator is cost effective for an industry if the simulator costs ______________ than the machine the students are being trained to use.
A. less
B. more
C. the same as
D. doesn't matter

MANAGEMENT INFORMATION SYSTEMS

1. Record Keeping
2. Personnel System
3. Energy Monitoring
4. CAI
5. Simulation Modeling

DATA MANAGEMENT RECORD KEEPING

1. Billing
2. Accounting
3. Payroll
4. Inventorying
5. Personnel Data Information
6. Scheduling/Routing
7. Reporting

AN INVENTORY CONTROL SYSTEM

1. RECORDKEEPING

2. MATERIALS AND SUPPLY MANAGEMENT
    A. INVENTORY
    B. BILL OF MATERIALS
    C. SCHEDULING

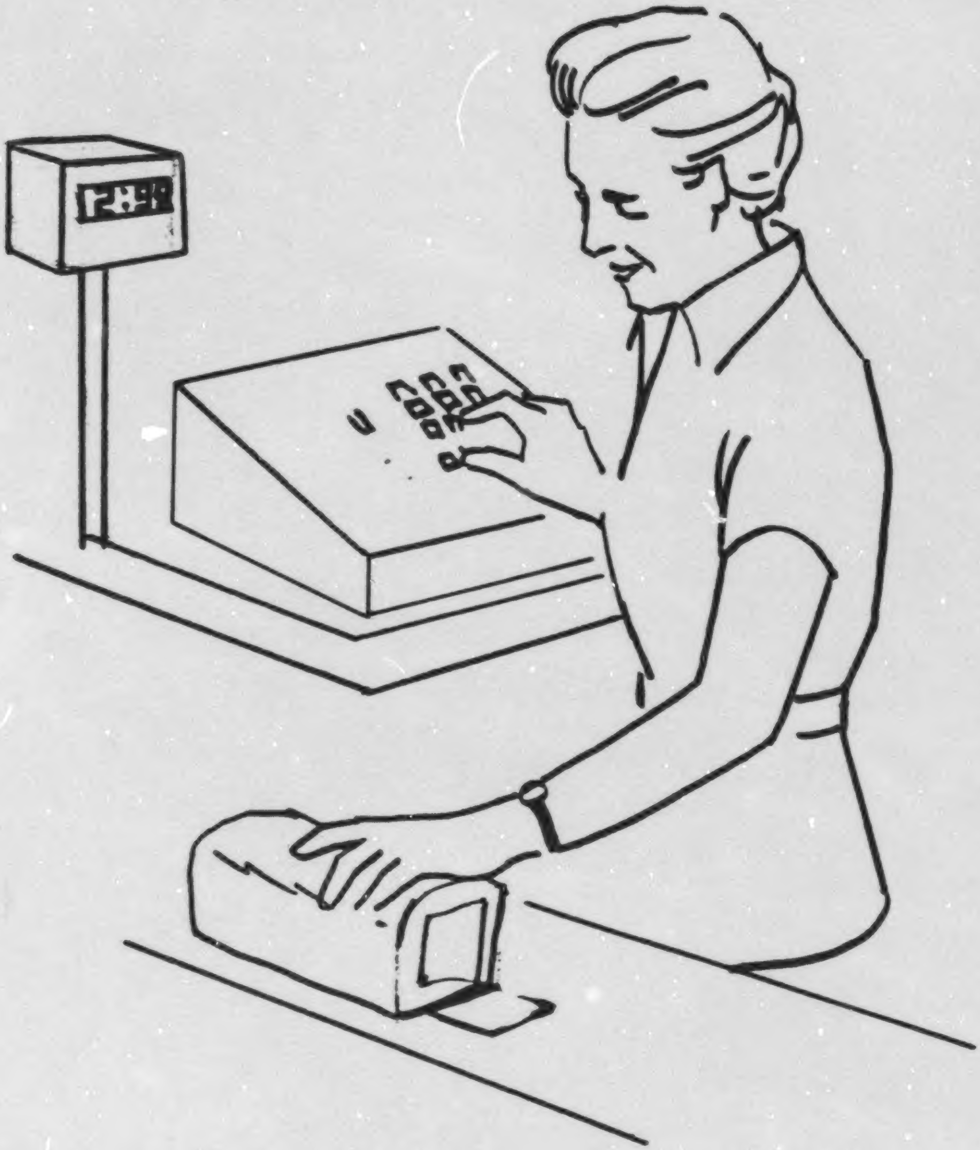
3. COMMUNICATIONS MANAGEMENT
    A. WORD PROCESSING
    B. TELECOMMUNICATIONS
    C. MASS MAILOUTS

4. SAFETY MANAGEMENT
    A. PERSONNEL
    B. INDUSTRIAL
    C. ENVIRONMENTAL

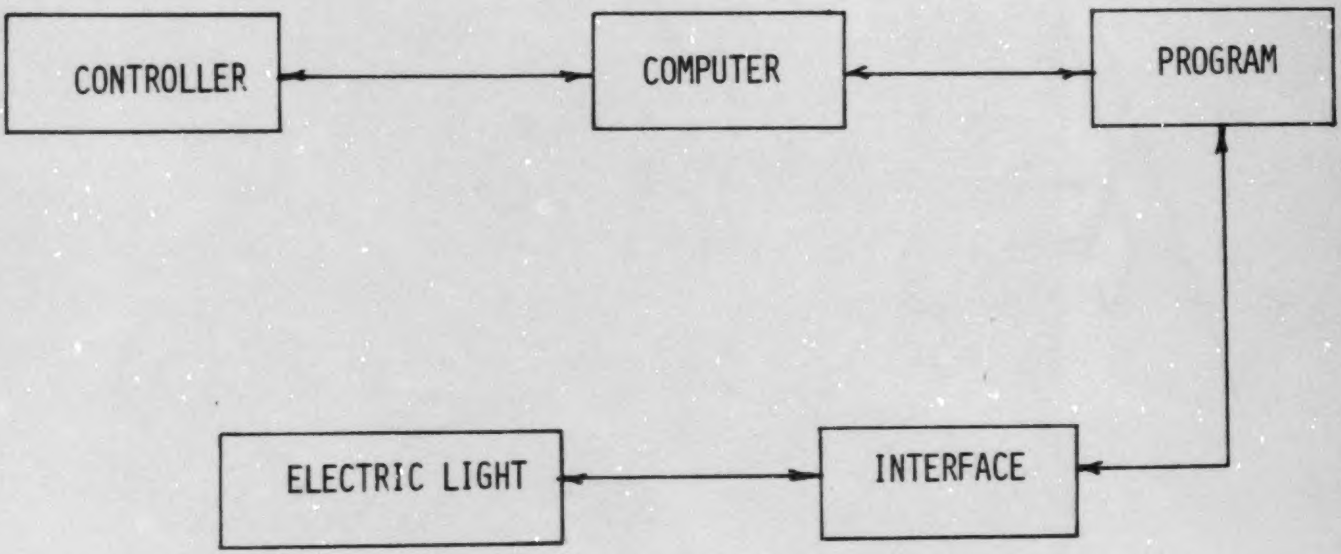
USING COMPUTERS TO MANAGE COMMUNICATIONS

1. Word Processing
2. Telecommunications
3. Electronic Mail
4. Uniform Product Code
5. Electronic Funds Transfer

UNIFORM PRODUCT CODE



USING COMPUTERS TO MONITOR THE USE OF ENERGY


CONTROLLER
COMPUTER
PROGRAM
ELECTRIC LIGHT
INTERFACE

COMPUTER-ASSISTED INSTRUCTION

CAI TEACHES BY SHOWING THE STUDENT INFORMATION ABOUT A SUBJECT, THEN ASKING THE STUDENT A SERIES OF QUESTIONS ABOUT THE INFORMATION. IF A STUDENT ANSWERS THE QUESTIONS INCORRECTLY, THE STUDENT IS SENT BACK TO REVIEW THE INFORMATION AGAIN. IF THE QUESTIONS ARE ANSWERED CORRECTLY, THE STUDENT IS SHOWN NEW INFORMATION. THUS, THE STUDENT LEARNS THE INFORMATION AT THE STUDENT'S OWN PACE.

4

Computer-Aided Manufacturing (CAM)

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. define the term **CAM** adequately;
2. use a computer to generate planning activities;
3. use a computer to aid in financial planning;
4. use a computer to report the results of quality control inspections;
5. use a computer to manage production;
6. understand how computers are used to manage space industrialization; and
7. identify how the principles of CAM can be applied to industry.

KEY WORDS: VOCABULARY

The words below may be new to students studying computer applications. Teachers should help students understand these words as they are used in this topic of study.

CAM
planning
financial planning
flow chart
PERT chart
trend forecasting
space industrialization
quality control

TEACHING AIDS

- Personnel data software package
- Trend forecasting software package
- Financial software package
- Quality control software package
- Audiovisual pens
- Magazines
- Newspaper clippings
- Computer
- Films/slide series/videotape
- Test Key: 1-C, 2-B, 3-D, 4-C, 5-A, 6-B, 7-D, 8-C
- Transparencies: You will find transparencies CA4-1 through CA4-6 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to students while they are studying different aspects of this unit.
  CA4-1: What Is CAM?
  CA4-2: Flow Charting
  CA4-3: PERT Charting
  CA4-4: Using the Computer for Financial Planning
  CA4-5: Using the Computer to Manage Production
  CA4-6: Computers and Space Industrialization

SUGGESTED REFERENCES

Ehricke, K. Industries in Space to Benefit Mankind: A View Over the Next Thirty Years. Downey, Calif.: Rockwell International, 1977. (NAS8-32198)

____________. Exploring Space. New York: Derrydale Books, 1979.

Fales, J., et al. Manufacturing: A Basic Text for Industrial Arts. Bloomington, Ill.: McKnight Publishing Co., 1980.

Graham, Neill. The Mind Tool Computers and Their Impacts on Society. New York: West Publishing Co., 1983.

Grey, J. Enterprise. New York: William Morrow, 1979.

Heppenheimer, T. A. Colonies in Space. Harrisburg, Pa.: Stackpole Books, 1977.

Lueg, R. Planning for Materials Processing in Space. Huntsville, Ala.: George C. Marshall Space Flight Center, 1977.

Story, C. H. Solar Power Satellite Stations: An Evaluation of Transportation Options from Earth Orbit to Geosynchronous Orbit. Houston: NASA/ASEE Institute, Johnson Space Center, 1976.

SENTENCE OUTLINE

- I. What Is CAM? **(Transparency CA4-1)**
  - A. Computer-aided manufacturing (CAM) is a system of planning, organizing, and controlling industrial functions and operations.
  - B. CAM involves planning activities, financial planning, quality control, inspection reporting, and managing production.
  - C. Traditionally, one thinks of these functions or operations as taking place in a factory.
  - D. However, the management of space industrialization is changing this concept.
  - E. We will soon be managing transportation, manufacturing, and construction activities in space, as well as on earth.
- II. Using the Computer to Plan Activities
  - A. The computer has replaced traditional planning methods in industry.
  - B. Now planning activities for an industrial project can be completed in a matter of hours, with only one person operating a computer, instead of six to twelve planners working two weeks to complete the same job without a computer.
  - C. This results in companies becoming more competitive in the bidding process.
  - D. More innovative and detailed planning techniques can be performed on the computer versus traditional methods of planning.
    - 1. Intricate flow charts and PERT charts can be graphically represented on a computer, hardcopied on a printer, and sent across a network to those individuals needing the information in-house and out-of-house. A complete job description and bill of materials would be included with the chart.
      - a. A **flow chart** is a graphic representation showing the overall production plan. **(Transparency CA4-2)**
      - b. A **PERT chart** is a graphic representation showing every phase of production, how the different phases of production interface, and how long each phase will take to complete. **(Transparency CA4-3)**
    - 2. **Trend forecasting** can be performed with greater speed and more accuracy by a computer.
    - 3. Large amounts of data can be stored and retrieved in a matter of seconds to predict future trends and needs of the company.
    - 4. Companies traditionally plan for about 5 years, but the computer allows them to plan for up to 30 years, if not more.
  - E. By using the computer to manage planning activities, this phase of management is unlimited.
- III. Using the Computer for Financial Planning **(Transparency CA4-4)**
  - A. The success of a company relies on how well a company plans its finances.
  - B. A financial model can be set up for a company on the computer and managed through the computer. A spreadsheet simulation program can be used for this.
    - 1. The financial model is used to evaluate overall strategies that guide the company's operations.
    - 2. The financial model also budgets operating funds.
  - C. Through using a computer for financial planning, a company can manage the following financial applications:

1. budgeting
2. financing
3. cost-flow analysis
4. investments
5. marketing and productions

D. The following computer programs will be useful in financial planning:

1. estimating costs
2. Treasury bills
3. interest on bonds
4. continuous interest compound
5. tax deduction
6. present value of investment
7. future value of investment
8. depreciation switch
9. internal rate of return
10. mortgage amortization
11. trend forecasting

IV. Using the Computer to Report Quality Control Inspection

A. Computers can be used to record and report quality control information at a high rate of speed and with greater accuracy.

B. By using a computer to report quality control inspection, problems can be corrected on-line instead of in the field.

C. The computer can be used to monitor and report production efficiency, showing the total relationship of all the fabrication and production areas on a particular product.

D. Quality control software packages are available for general situations; however, unprotected versions can be modified to a specific company or situation.

V. Using the Computer to Manage Production (CAE) **(Transparency CA4-5)**

A. Computer-assisted engineering (CAE) is the total production process being managed through the computer.

B. Planning and tooling up for production can be managed through the computer.

C. CAD, CNC, and robotic systems are managed through computers to produce goods.

D. Today, some companies control the entire production process through a centrally located computerized control unit, operated only by a few employees. This is done in a totally paper-free environment.

E. By the turn of the century, most companies will be totally automated with only a few employees managing production. This could possibly be done from another site outside the industry or from another city.

F. The computer will be used to process orders, schedule production, control machines, make corrections during production, control inventory, manage marketing and advertising, and control shipping.

VI. Computers and Space Industrialization **(Transparency CA4-6)**

A. Managing space industrialization will soon become the most demanding use of CAM networks.

B. CAM systems will soon be managing space environmental transportation systems, communication systems, manufacturing activities, construction activities, power for operating space systems, and special vehicles for space operations.

C. Computers will be used to control robots in space manufacturing and construction activities.

D. Large communication dishes will soon be constructed in space to manage security and provide instant communications anywhere in the world.

E. Permanent manned space stations will soon be a reality, and their success and efficiency will be based on the computer and its ability to perform sophisticated management systems.

MATERIALS FOR STUDENTS

- Appendices A and B
- Computer software packages
- Vocabulary Worksheet

SUGGESTED STUDENT ACTIVITIES

Use appropriate computer program in Appendix A or other software package.

1. Have students write computer programs that simulate CAM operation. Have one program allow entry of X and Y coordinates, then have a second program read the coordinates and show them on the screen.
2. Have students construct a simple CAM device, such as an electric motor that moves a piece of material from one place to another.
3. Have students examine a traditional machine tool (a drill press is probably easiest) and estimate how many more electrical motors would be needed to make it a CAM machine tool.
4. Bare-board microprocessors are inexpensive. Have students acquire a four-bit microprocessor and examine its structure and abilities in detail.
5. Have students write a simulation of a CAM operating system. The completed program should send some form of positioning and control commands to the screen, illustrating the flow of instructions from an operating system to a machine.
6. Have students construct a chart or model of an automated factory. What parts of a conventional factory are unnecessary to an automated factory? Do the CAM systems and robotics force a new type of factory design?
7. Have students research an area of space industrialization and how computers will be used in that particular area. Then have the students build a model to depict their research.

Vocabulary Worksheet

1. CAM
2. planning
3. financial planning
4. flow chart
5. PERT chart
6. trend forecasting
7. space industrialization
8. quality control

TEST

Unit 4: Computer-Aided Manufacturing (CAM)

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: __C__ 21. The class you are now attending is—
A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. CAM is the use of ____________________ to run machines or tools.
A. BASIC
B. mathematics
C. computerized instruction
D. robotics

___ 2. In a CAM factory, blueprints and drawings are prepared by—
A. NC systems
B. CAD systems
C. drafters
D. engineers

___ 3. A CAM system positions itself by using—
A. a ruler
B. a remote control monitor
C. sensors
D. X and Y coordinates

___ 4. An operating system is usually written in—
A. English
B. computerized instructions
C. assembly language
D. COBOL

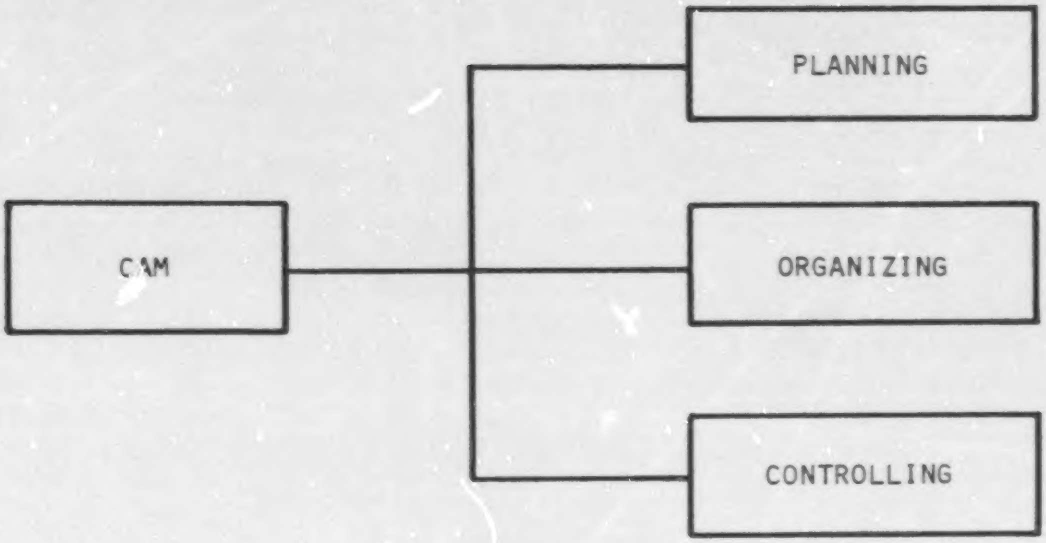
___ 5. One type of CAM operating system is called—
A. point to point
B. remote sensing
C. networking
D. CAD

___ 6. An automated factory would need—
A. machinists
B. system operators
C. assembly line workers
D. material handlers

___ 7. An automated factory uses—
A. just CAD
B. human-operated lathes
C. adding machines
D. CAD, CAM, and robotics

___ 8. If all factories were automated, a bad profession to be in would be—
A. programming
B. system operating
C. drill press operator
D. CAD operator

WHAT IS CAM?



CAM

PLANNING

ORGANIZING

CONTROLLING

FLOW CHARTING

PRODUCT NAME	FLOW BEGINS	FLOW ENDS	DATE
PREPARED BY: SECTION:		APPROVED BY:	
PROCESS SYMBOLS & NUMBER USED	○ OPERATIONS___ □ INSPECTIONS___ ⇨ TRANSPORTATIONS___ D DELAYS___ ▽ STORAGES___		

TASK NO	PROCESS SYMBOLS	DESCRIPTION OF TASK	MACHINE REQUIRED	TOOLING REQUIRED
	○ ⇨ □ D ▽			
	○ ⇨ □ D ▽			
	○ ⇨ □ D ▽			
	○ ⇨ □ D ▽			
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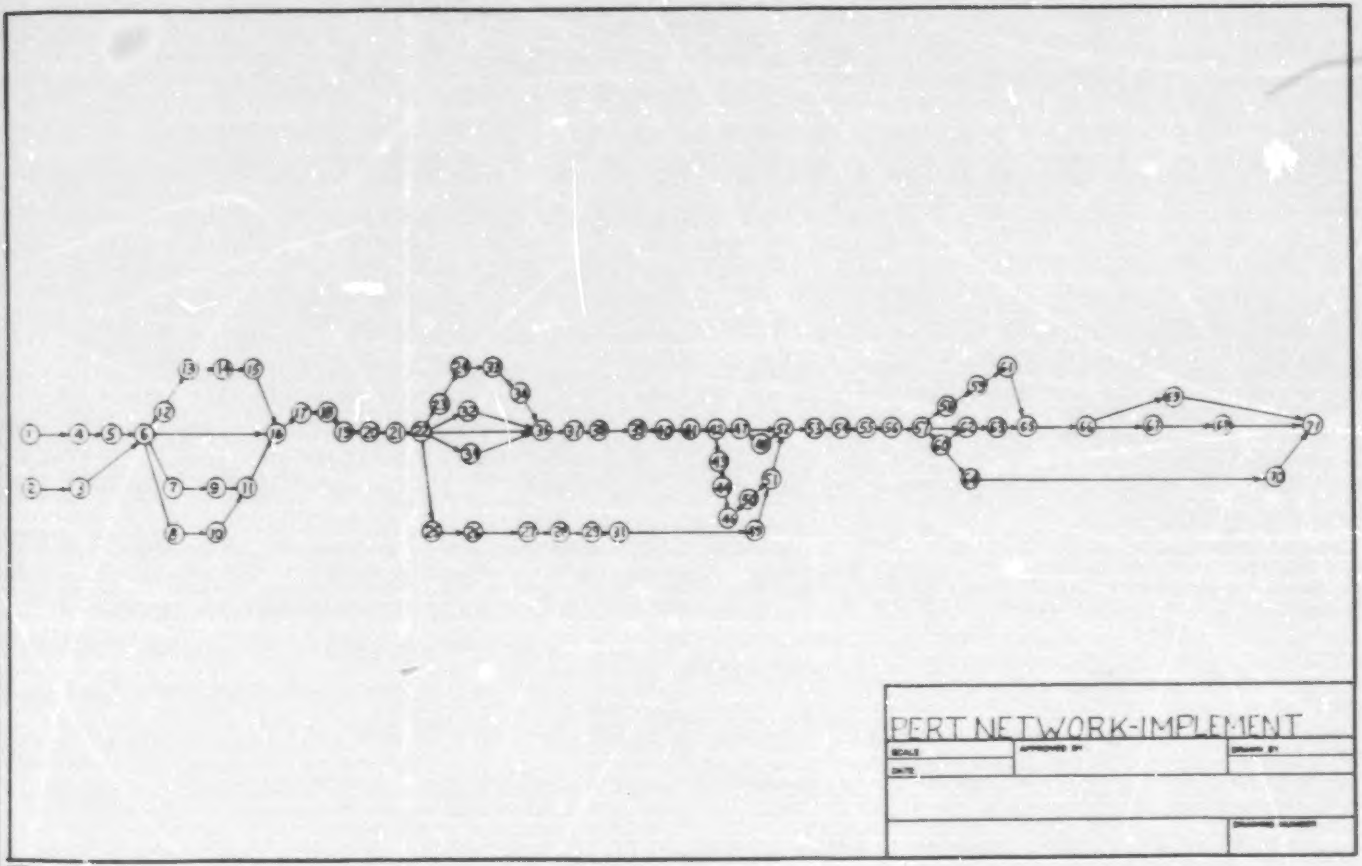
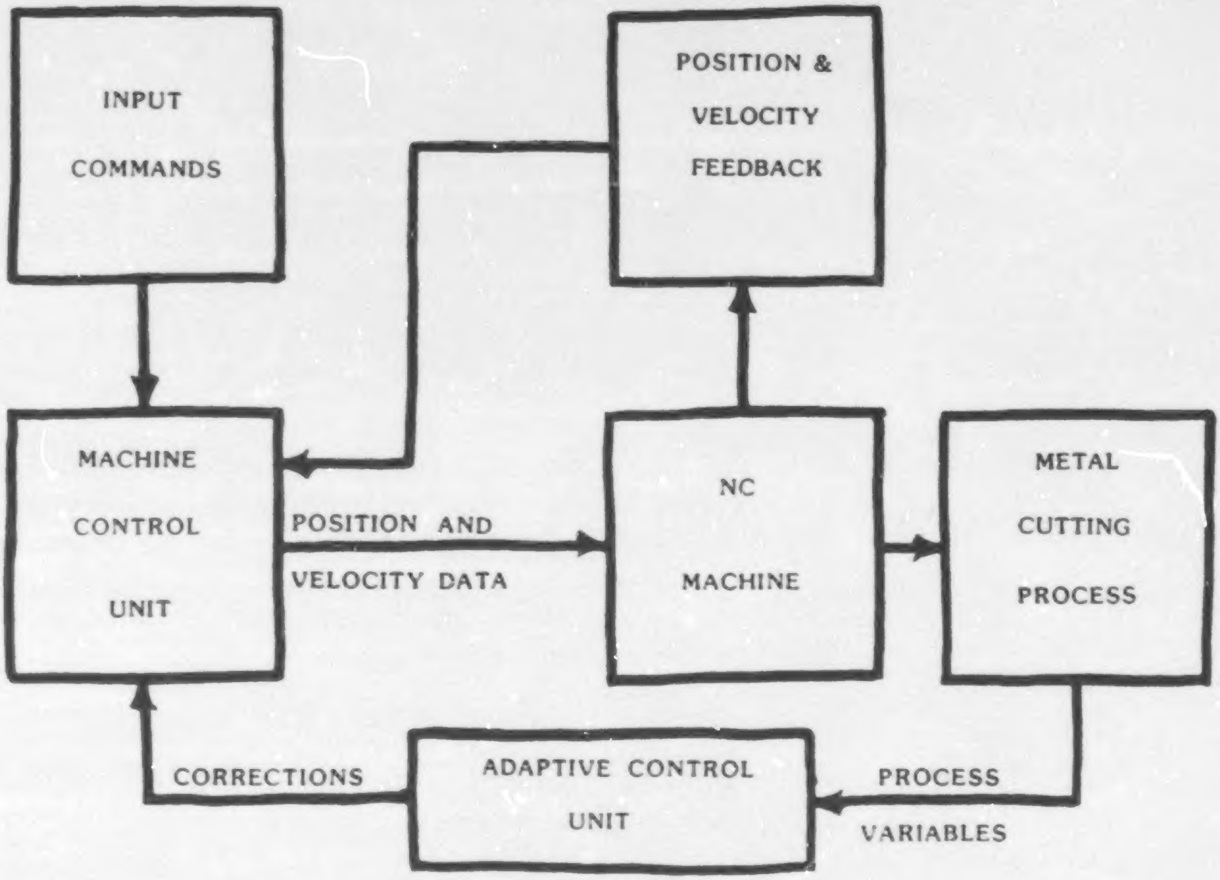
PERT CHARTING


PERT NETWORK-IMPLEMENT
SCALE
DATE
APPROVED BY
DRAWN BY
DRAWING NUMBER

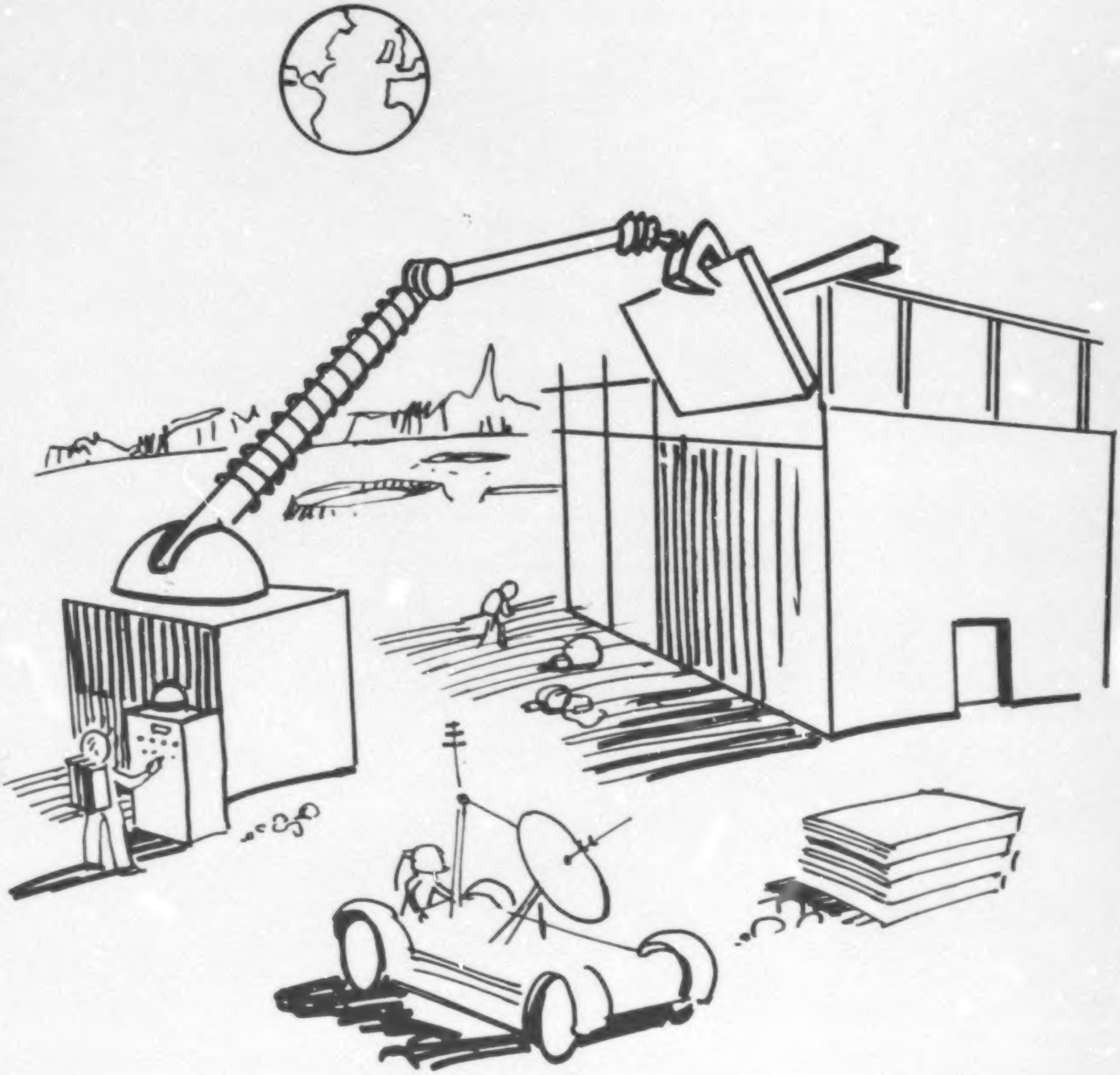
USING THE COMPUTER
FOR FINANCIAL PLANNING

1. BUDGETING
2. FINANCING
3. COST-FLOW ANALYSIS
4. INVESTING
5. MARKETING AND PRODUCTIONS

USING THE COMPUTER TO MANAGE PRODUCTION


INPUT COMMANDS
POSITION & VELOCITY FEEDBACK
MACHINE CONTROL UNIT
POSITION AND VELOCITY DATA
NC MACHINE
METAL CUTTING PROCESS
CORRECTIONS
ADAPTIVE CONTROL UNIT
PROCESS VARIABLES

COMPUTERS AND SPACE INDUSTRIALIZATION



5

Computer-Aided Drafting (CAD)

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. define the term CAD adequately;
2. identify the major components of a CAD system;
3. identify the coordinate system used in CAD (Cartesian, 2D, and 3D);
4. be familiar with characteristics essential to basic CAD systems;
5. be familiar with the types of input and output devices used with CAD systems;
6. operate a CAD system to produce a drawing;
7. gain an understanding of the reasons the CAD system is being used in many areas of industry; and
8. identify the advantages and disadvantages of CAD applications in a technology setting.

KEY WORDS: VOCABULARY

The words below may be new to students studying computer applications. Teachers should help students understand these words as they are used in this topic of study.

snap
window
menu
digitizer
plotter
CRT
zoom
font
grid
cursor
prompt
syntax
scale
joystick
printer

TEACHING AIDS

- CAD workstation
- Audiovisual pens
- Newspaper clippings
- Magazines
- Films and/or slide series
- Test Key: 1-A, 2-B, 3-C, 4-A, 5-D, 6-B
- Transparencies: You will find transparencies CA5-1 through CA5-4 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to students while they are studying different aspects of this unit.
  CA5-1: Definition of CAD
  CA5-2: Definition of a Digitizer
  CA5-3: Definition of a Plotter
  CA5-4: A CAD System

SUGGESTED REFERENCES

Books

Besant, C. B. Computer Aided Design and Manufacturing. New York: John Wiley, 1980.
Goetsch, D. L. The CAD/CAM Workbook. Cincinnati: South-Western Publishing, 1983.

Prince, M. Interactive Graphics for Computer-aided Design. Reading, Mass.: Addison-Wesley, 1971.
Ryan, D. L. Computer Aided Graphics and Design. New York: Marcel Dekker, 1979.
Vlietstra, J., and Wielinga, R. F., eds. Computer-aided Design. Amsterdam, Holland: North-Holland Publishing, 1973.

Periodicals

Design Graphics World. Monthly. Communications Channels, Inc., New York.
Computer Graphics World. Monthly. Pennwell Publishing Co., Advanced Technology Group, San Francisco, Calif.

SENTENCE OUTLINE

I. Definitions of Computer-Aided Drafting (CAD) Basic Units
  A. **Computer-aided drafting** (CAD) is a process involving direct, real-time communication between a drafter and a computer, generally by the use of a cathode-ray tube (CRT) display and a digital input method. **(Transparency CA5-1)**
  B. **Digitizer** is an input device to convert a measurement into a digital value. In computing, this is normally done automatically and consists of converting an electrical signal into a binary number. **(Transparency CA5-2)**
  C. **Plotter** is an output unit that graphs data by an automatically controlled pen. Data is normally plotted as a series of incremental steps. Primary types of plotters are the drum plotter and the flat-bed plotter. **(Transparency CA5-3)**

II. History of CAD
  A. Our everyday activities have been dramatically changed as a result of the development of the computer.
    1. CAD, or computer graphics, is not a new field.
    2. As soon as numbers were displayed on a screen or printed page, programs were written to convert this data to graphic form in charts and graphs.
    3. Historians and buffs tell us that there are two branches to the "computer family."
      a. One branch began with finger counting and the abacus (600 B.C.) and has continued through the years to the "digital computer" of today.
      b. The other branch began with Napier and his logarithms, then to the slide rule, and finally the "analog computer."
    4. The first "graphical output" was produced by a line printer and, until 1957, the printer was the only graphical device.
    5. In 1957, a college graduate student developed a way of using a numerical control (NC) machine to make engineering drawings. His thesis received little attention, although in a simultaneous development, engineers at General Dynamics in Fort Worth, Texas, used NC-generated drawings to check the output of the NC machines.
    6. The first crude commercial computer graphics systems were developed in 1963.
      a. The systems required the user to assemble both the hardware and software.
      b. The most significant system was I. E. Sutherland's "Sketch Pad" that was implemented on the "TX-2" computer at the M.I.T. Lincoln Laboratory.
      c. A system that paralleled the Sutherland system was the "DAC-1" graphics system developed by IBM for General Motors.
  B. Today's graphic systems are available in many different forms. **(Transparency CA5-4)**
    1. The microcomputer revolution of the last decade has dramatically changed the use of computers in industry and in our everyday activities.

2. One area of rapid growth and change is the use of microcomputers in the design and manufacturing process.
3. Many different CAD and CAD/CAM systems are used by drafters, designers, and engineers to design, analyze, and refine products and processes.

III. CAD in Industry
   - A. CAD provides industry with the tools to integrate a large variety of manufacturing design and processes together.
   - B. The designer or drafter can use CAD systems to develop "data base" information that can be used to control automated manufacturing and robotics to improve the efficiency of the industry.
   - C. CAD allows the designer or drafter to spend more time for creative and productive thinking.
   - D. CAD makes the job of designing and drafting easier, more accurate, and faster.

IV. The Computer "Terminal"
   - A. The computer "terminal" is the device used to communicate with the computer.
   - B. The most visible part of the terminal is the CRT (cathode-ray tube).
     1. The CRT is the television-type screen used to view the data stored in the computer's memory.
     2. The CRT can be one color (monochrome) or multicolor to aid in the identification of different parts of the drawing.
     3. Each dot of light on the CRT is called a "pixel."
     4. Hi-resolution CRTs use a larger number of "pixels" on the screen to show a more accurate drawing.
   - C. Keyboard
     1. An experienced CAD user will input most of the data used to make a drawing by using a typewriter keyboard.
     2. Most keyboards used with CAD systems will have the standard typewriter keys, a numeric key pad, and a number of special function keys.

V. The Digitizer
   - A. The "digitizer" is added to the terminal as an input device to make data entry easy, by using a menu.
   - B. A digitizer converts electronic signals into precise locations relative to a given origin point.
   - C. We live in a three-dimensional world, but many times it is easier to represent products in a two-dimensional (orthographic) form.
     1. X-Y coordinate systems are known as "2D."
     2. Methods of 2D digitizing include use of a light pen that can be read by the "CRT," or a pad that recognizes X-Y locations when touched with pen or when a puck button is pressed.
     3. X-Y-Z coordinate systems are known as "3D."
     4. Methods of 3D digitizing include use of arms or sensors that can read X-Y-Z locations on a given command.
   - D. Names commonly used for a digitizing input are joystick, pad, mouse, puck, light pen, and touch screen.

VI. The Plotter
   - A. A plotter is an output device that uses an "NC" pen as a tool to produce a drawing.
   - B. A drum-type plotter gets its name from the use of a roll of paper that is moved back and forth across the plotter while the pen is moved from side to side.
   - C. Newer and smaller drum-type plotters use cut sheet paper, but still move the paper in one direction while moving the pen in the opposite direction.
   - D. A flat-bed type plotter uses a flat drawing surface and moves the pen in both the X and Y directions.
   - E. Both types of plotters come sized to work with standard drawing paper sizes.
   - F. Most software CAD systems will also allow hardcopy to be made on a dot matrix printer.

    G. Special types of plotters can use light pens to make photographic plates used in printing applications.

VII. Software
  A. CAD software is available today to run on most microcomputers.
    1. Just a few years ago, it required a large main frame with very large memory units to use CAD software.
    2. The user also had to be a programmer. The CAD applications had to be written in a language that the computer could understand.
    3. Today, software is written that uses easy-to-understand menus to call preprogrammed geometric shapes.
    4. The software today can run on most microcomputers with extended memories.
    5. Most software today can receive instructions from the keyboard and a digitizer.
    6. There are two major types of CAD software—2D (two-dimensional) and 3D (three-dimensional).
    7. 2D CAD is similar to making a drawing on a two-dimensional sheet of paper. Any type of drawing that can be made in a traditional drawing method can be entered into a 2D CAD system.
    8. 3D CAD is similar to building models using all three space dimensions of width, height, and depth at the same time.
  B. The "menu" is used to help the designer/drafter to draw geometric shapes with the touch of a key.
    1. A CAD menu is a list of names and geometric constructions used in drafting and a list of functions that the computer can perform. Example names included in most lists are: draw, line circle, arc, dimension, erase, save, zoom, window, copy, move, color, level, and many more.
    2. To draw a line with a T-square and a pencil, you have to know how to sharpen and hold the pencil; where to start and stop the line, and how to hold the T-square in the correct location.
    3. To draw a line with a CAD system, you have to know where to start and stop the line, and which key or keys on the keyboard or digitizer to press.
    4. The time saved is in the physical act of drawing the line, not in the thinking time required to determine where to put the line or the understanding of what the line stands for on the drawing.

VIII. The Future of CAD Systems
  A. The future of CAD systems will see many new items of both hardware and software added to make them a more powerful design and drafting tool.
  B. Look for flat-panel, color graphics display big enough to show a D-size drawing at 1:1 size.
  C. Display areas will be segmentable into multiple user-definable windows.
  D. Each work station will have its own processor with as much as 10 gigabytes (10 to the 10th power) of local on-line storage, a display controller, and high-speed (20 Mh) local networking interfaces.
  E. Data input and output readers and writers will probably be an integral part of each work station.
  F. A user-programmable function keypad will probably be provided for commonly used functions.
  G. Better data management and performance features will make significant changes.
  H. CAD systems will become a major tool of the designer and drafter.

MATERIALS FOR STUDENTS

- CAD work station
- Operating instructions

- Standard drafting problems
- Vocabulary Worksheet

SUGGESTED STUDENT ACTIVITIES

Use appropriate computer program in Appendix A or other software package.

1. Have students make a drawing using CAD software.
2. Have students make a list of examples of computer-aided graphics seen in everyday activities.
3. Have students make a list of things that a CAD system can help them do.
4. Have students design and draw the plans for a mass-production activity.

Vocabulary Worksheet

1. snap
2. window
3. menu
4. digitizer
5. plotter
6. CRT
7. zoom
8. font
9. grid
10. cursor
11. prompt
12. syntax
13. scale
14. joystick
15. printer

TEST

Unit 5: Computer-Aided Drafting (CAD)

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: __C__ 21. The class you are now attending is—
A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. It is a process involving direct, real-time communications between a drafter and a computer, generally by the use of a cathode-ray tube (CRT) display and a digital input method:
A. CAD
B. CNC
C. CAM
D. CAE

___ 2. An input device that converts a measurement into a digital value is the—
A. analyzer
B. digitizer
C. logger
D. plotter

___ 3. An output device that graphs by an automatically controlled pen is the—
A. pen set
B. Rapid-o-graph
C. plotter
d. digitizer

___ 4. A device used to display output is the—
A. CRT
B. digitizer
C. pixel
D. cursor

___ 5. A dot of light in the CRT is called a—
A. dot
B. ray
C. strobe
D. pixel

___ 6. This is a digitizing input.
A. pixel
B. mouse
C. ray
D. cursor

DEFINITION OF CAD

COMPUTER-AIDED DRAFTING IS A PROCESS INVOLVING DIRECT, REAL-TIME COMMUNICATION BETWEEN A DRAFTER AND A COMPUTER, GENERALLY BY THE USE OF A CATHODE-RAY TUBE (CRT) DISPLAY AND A DIGITAL INPUT METHOD.

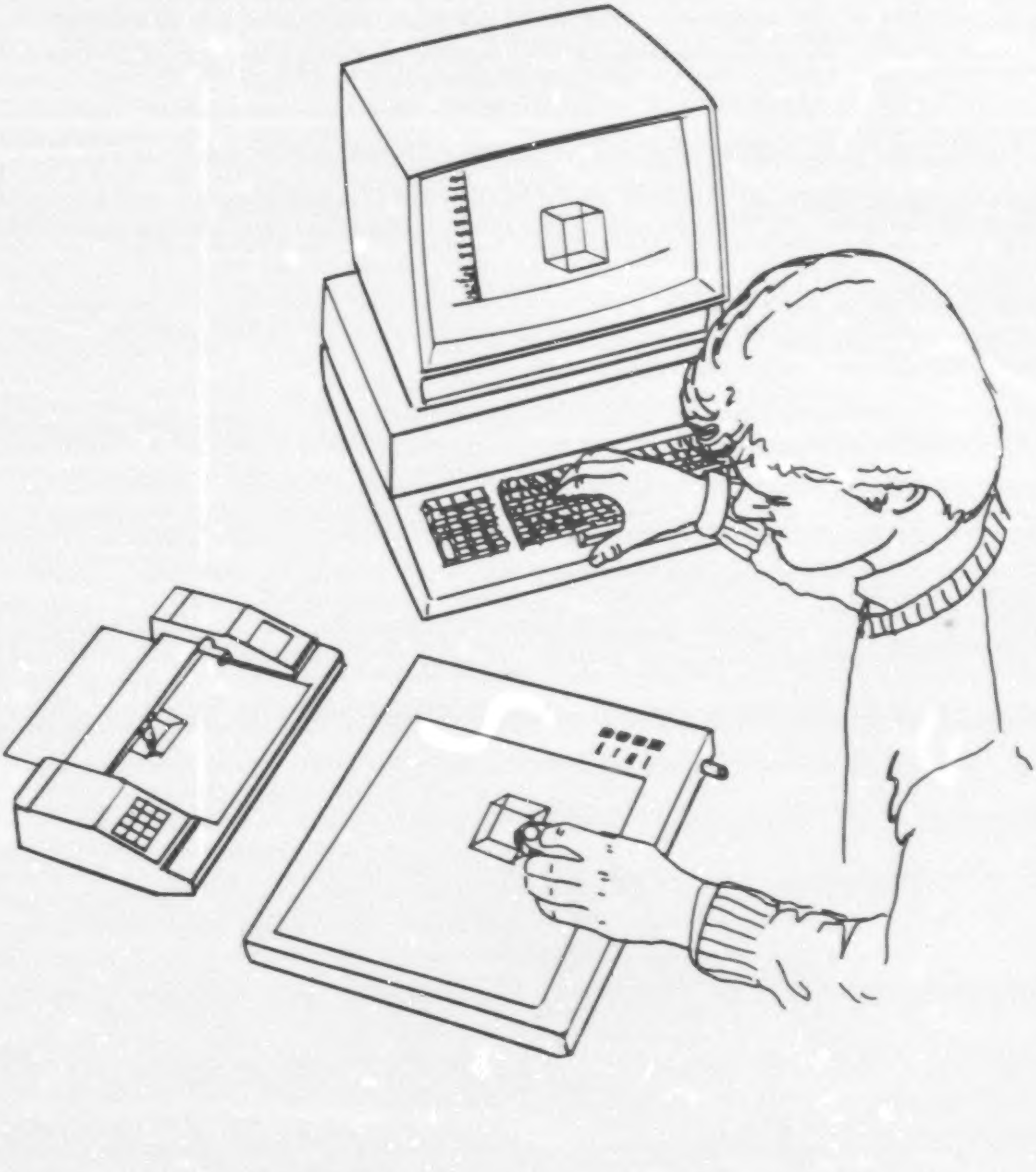
DEFINITION OF A DIGITIZER

DIGITIZER IS AN INPUT DEVICE TO CONVERT A MEASUREMENT INTO A DIGITAL VALUE. IN COMPUTING, THIS IS NORMALLY DONE AUTOMATICALLY AND CONSISTS OF CONVERTING AN ELECTRICAL SIGNAL INTO A BINARY NUMBER.

DEFINITION OF A PLOTTER

PLOTTER IS AN OUTPUT UNIT THAT GRAPHS DATA BY AN AUTOMATICALLY CONTROLLED PEN. DATA IS NORMALLY POTTED AS A SERIES OF INCREMENTAL STEPS. PRIMARY TYPES OF PLOTTERS ARE THE DRUM PLOTTER AND THE FLAT-BED PLOTTER.

A CAD SYSTEM



6

Computer Numerical Control (CNC)

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. define the term CNC adequately;
2. identify the difference between NC and CNC;
3. identify the major parts of a CNC system;
4. identify the difference between absolute and incremental positioning;
5. be familiar with the characteristics essential to CNC systems;
6. be familiar with the various types of tooling operations used in CNC systems;
7. operate a CNC machine through a computer;
8. gain an understanding of the reasons why CNC is being used in many areas of industry; and
9. identify the advantages and disadvantages of CNC installations in various technological settings.

KEY WORDS: VOCABULARY

The words listed below may be new to students studying computer applications. Teachers should help students understand these words as they are used in this topic of study.

computer numerical control
numerical control
adaptive control
G-functions
M-functions
assembly language
FORTH
sensors
absolute system
incremental system
servomechanism
point-to-point control
contour control

TEACHING AIDS

- CNC system
- Audiovisual pens
- Magazines
- Newspaper clippings
- Computer
- Films and/or slide series
- Test Key: 1-B, 2-A, 3-D, 4-C, 5-B, 6-D
- Transparencies: At the end of this unit, you will find transparencies CA6-1 through CA6-9. If you wish, these masters may be duplicated in quantity and given as handouts to students while they are studying different aspects of this unit.
  CA6-1: What Is NC?
  CA6-2: What Is CNC?
  CA6-3: How NC Works
  CA6-4: How CNC Works
  CA6-5: Adaptive Control System
  CA6-6: Types of Control
  CA6-7: G-Functions
  CA6-8: M-Functions
  CA6-9: Advantages of NC and CNC

SUGGESTED REFERENCES

Child, James J. Principles of Numerical Control. New York: Industrial, 1982.

Patton, William J. Numerical Control Practice and Applications. Reston, Va.: Reston Publishing Co., 1972.

SENTENCE OUTLINE

I. What Are NC and CNC? **(Transparency CA6-1)**
  A. The Electronics Industries Association defines **numerical control** (NC) as a system in which actions are controlled by the direct insertion of numerical data at some point. The system must automatically interpret at least some portion of this data.
  B. A **computer numerical control** (CNC) system uses computer programs stored in its storage area or in a centrally located main computer. This information is passed on to the machine's control unit. The control unit processes each command in turn. Like the NC system, CNC uses feedback to check its operations and adjust if necessary. **(Transparency CA6-2)**

II. The History of CNC
  A. In 1948, John Parsons and Frank Stulen developed numerical control (NC) at the Parsons Corporation, Traverse City, Michigan.
  B. The U.S. Air Force and the servomechanical laboratory at M.I.T. refined Parsons' work in 1949.
  C. In 1952, M.I.T. finished 3-axis simultaneous, Cincinnati, Ohio.
  D. Numerical control was announced to the public in 1954.
  E. In 1955, the Industrial Manufacturing Technical Society exhibited the first NC machine, Sundstrand Lathe with a G.E. control.
  F. The Illinois Institute of Technology developed the APT (automatically programmed tool) language.
  G. In 1965, NC began to appear on a limited basis.
  H. In 1970, CAM (computer-aided manufacturing) was developed to aid programming.
  I. CNC (computer numerical control) sprang into full life in 1976.
  J. In 1977, microelectronic reliability was expanded.
  K. Adaptive controls use was expanded.
  L. FMS (flexible machining systems) was expanded in 1978.
  M. In 1981, additions of CNC to all types of machine tools, forming equipment, grinding, and measuring took place.

III. How NC and CNC Work **(Transparencies CA6-3 and CA6-4)**
  A. There are five basic parts of a CNC system:
    1. CAD-produced drawing
    2. computer processing and storage unit
    3. magnetic tape, punch cards, or punch tape
    4. checking of tool paths (feedback loops)
    5. production (machining)
  B. An NC system uses a paper tape and tape reader to operate a machine or tool; a CNC system uses a microprocessor to operate a machine. Because the microprocessor is actually a small computer, CNC systems are more flexible than NC systems. They are also more expensive.
  C. Most NC and CNC systems use a special computer language called automatically programmed tool (APT) language. APT instructions are called **functions.** Each function corresponds to one machine function or operation.
    1. Assembly language is also used with some CNC systems. Assembly language is more difficult to write than APT (or BASIC), but its speed is much faster than APT.

    2. FORTH is a computer language with features that fully support machine control. The use of FORTH in CNC systems is increasing as programmers become familiar with it.

D. A conventional NC system operates a machine by reading each command in turn from a tape reader. The control unit then sends positioning and velocity commands to the machine. Sensors read the position and velocity of the machine as it operates and send this data back to the control unit, which uses this feedback information to send new positioning and velocity commands to the machine.

E. A CNC machine uses programs stored in its storage area or in a centrally located main computer. This information is passed to the machine's control unit. The control unit processes each command in turn. Like the NC system, CNC uses feedback data to check its operations and adjust them if necessary.

F. NC and CNC use two types of systems to tell the machine tool where to perform its next operation. Both types of systems use X and Y coordinates as their measuring systems.
    1. The **absolute system** calculates the location of its next operation by referring back to where it started. There is only one point of reference, and all other locations are determined from that one.
    2. The **incremental system** finds its next location by taking the present location and adding to or subtracting from a certain value, resulting in a new location. In the incremental system, each measurement is based on the previous location.

G. **Adaptive control** is a special form of feedback used to give better control to NC and CNC machines. An adaptive control unit uses information about the processes being performed by the machine while they are being performed. These data are called **process variables.** Using the process variables, the adaptive control unit analyzes the machine's operation and sends corrections to adjust the position and velocity data that it sends to the machine. **(Transparency CA6-5)**

H. A **servomechanism** is a machine that uses a small amount of power from a human operator to control a large amount of power on a machine or tool. Power brakes on a car are an example of a servomechanism. Servomechanisms have several uses in industry—material handling, remote machine control, and handling of radioactive materials.

I. Types of control (**Transparency CA6-6**)
    1. Point-to-point
        a. This type of control deals with equipment that performs operations at a specific position, and it does not affect the workpiece when moving from point to point.
        b. An example of point-to-point control is a numerically controlled drill press.
    2. Contour
        a. Unlike point-to-point control, contour control cuts continually along a prescribed path, and the workpiece is affected by its position.
        b. Examples are numerically controlled milling machines and lathes.

J. G-functions (**Transparency CA6-7**)
    1. These functions prepare the control system for information that is to follow in the block.
    2. Listing of G-functions

WORD (CODE)	EXPLANATION
G00	Used to denote a rapid, or other traverse, rate with point-to-point positioning.

WORD (CODE)	EXPLANATION
G01	Used to describe linear interpolation blocks and reversed for contouring.
G10, G11	Used with some hardware systems to express blocks of other than normal dimensions; a normal dimension being 9.9999 inches of movement in any one block.
G02, G03	Used with circular interpolation.
G04	A calculated time delay in which there is no machine motion (dwell).
G05, G07	Unassigned by EIA; may be used at the discretion of the machine tool or system builder.
G06	Parabolic interpolation.
G08	Acceleration code.
G09	Deceleration code.
G10, G11, G12	Normally unassigned for CNC systems.
G13, G14, G15, G16	Used to direct the control system to operate on a particular set of axes.
G17, G18, G19	Used to identify, or select, a coordinate plane for such functions as circuler interpolation or cutting compensation.
G20 through G32	Unassigned according to EIA standards; however, may be assigned by the control system or machine tool.
G33, G34, G35	A mode selected for machines equipped with thread-cutting facilities and generally referring to lathes.
G36 through G39	Unassigned.
G40	A command which will discontinue any cutter compensation.
G41	A code associated with cutter compensation where the cutter is on the left side of the work surface, looking in the direction of cutter motion.
G42	A code associated with cutter compensation where the cutter is on the right side of the work surface.
G43, G44	Used with cutter offset and refers to the displacement normal to the cutter path to adjust for the difference between the actual and programmed cutter radii or diameters.
G45 through G49	Unassigned.
G50 through G59	Reserved for adaptive control.
G60 through G69	Unassigned.
G70	Inch programming.
G72	Three-dimensional circular interpolation—CW.
G73	Three-dimensional circular interpolation—CCW.
G74	Cancel multiquadrant circular interpolation.

WORD (CODE)	EXPLANATION
G75	Multiquadrant circular interpolation.
G76 through G79	Unassigned.
G80	Command that will discontinue any of the fixed cycles G81 through G89.
G81	Drill, or spotdrill, cycle.
G82	Drill with dwell.
G83	Intermittent, or deep hole, drilling.
G84	Tapping cycle.
G85 through G89	Boring cycle.
G90	Absolute input.
G91	Incremental input.
G92	Used to preload registers to desired values.
G93	Inverse time feedrate.
G94	Inches (millimeters) per minute feedrate.
G95	Inches (millimeters) per revolution feedrate.
G96	Constant surface speed per minute.
G97	Spindle speed in revolutions per minute.
G98, G99	Unassigned.

K. M-functions (**Transparency CA6-8**)
  1. These functions give miscellaneous functions for specific operations.
  2. Listing of M-functions

WORD (CODE)	EXPLANATION
M00	Automatically stops the machine.
M01	Noted as an optional stop and acted upon only when the operator has previously signaled for this command by pushing a button.
M30	Noted as an end of tape command and goes slightly further than M02 code in that this code will rewind the tape and also automatically transfer to a second tape reader if incorporated in the control system.
M03	Start spindle rotation in a clockwise position.
M04	Start spindle rotation in a counterclockwise position.
M05	Stop spindle in a normal and efficient manner.
M06	Command to execute the change of a tool manually or automatically, not to cover the selection of a tool as is capable with the T words.
M07	Code to turn a coolant on.
M08	Also a code for turning a coolant on.
M09	Automatically shuts off the coolant.
M10, M11	M10 applies to the automatic clamping of the machine sides, workpiece, fixture spindle, etc.

WORD (CODE)	EXPLANATION
M12	An inhibiting code used for the synchronization of multiple sets of axes.
M13	Combines clockwise spindle motion and coolant on in the same command which will cause both to occur simultaneously.
M14	Combines counterclockwise spindle motion and coolant on in the same command.
M15, M16	Rapid traverse or feed motion in either the +(M15) or -(M16) direction.
M17, M18	Unassigned.
M19	Oriented spindle stop.
M20 through M29	Unassigned.
M31	A command known as an interlock bypass for temporarily circumventing a normally provided interlock.
M32	Unassigned.
M40 through M46	Used to signal gear changes if required at the machine, or otherwise unassigned.
M47	Continues program execution from the start of the program unless inhibited by the interlock signal.
M48	Cancel M49.
M49	A function which deactivates a manual spindle or feed override and returns the parameter to the programmed value.
M50 through M57	Unassigned.
M58	Cancel M59.
M59	A function which holds the RPM constant at its value when M59 is initiated.
M60 through M99	Unassigned.

L. Other address characters

ADDRESS CHARACTER	EXPLANATION
A	Angular dimension about the X axis.
B	Angular dimension about the Y axis.
C	Angular dimension about the Z axis.
D	Can be used to express either an angular dimension around a special axis, a third feed function, or a tool function for the selection of tool offset.
E	This address also may be used for expressing an angular dimension around a special axis or second feed function.
H	Unassigned.
I, J, K	Used in circular interpolation.
L	Not used.
O	Used in place of the customary "sequence number" word address N for a secondary head.

ADDRESS CHARACTER	EXPLANATION
P	A third rapid traverse code or tertiary motion dimension parallel to the X axis.
Q	Second rapid traverse code or tertiary motion dimension parallel to the Y axis.
R	First rapid traverse code or tertiary motion dimension parallel at an angle to the Z axis or the radius for constant surface speed calculation.
U	Secondary motion dimension parallel to the X axis.
V	Secondary motion dimension parallel to the Y axis.
W	Secondary motion dimension parallel to the Z axis.
End of Record	Used to stop rewind motion and generally represented by the character percent.

IV. Advantages of NC and CNC (**Transparency CA6-9**)
   A. Reduction of floor-to-floor production time.
   B. Savings in sheet-metal fabrication and machining time.
   C. Savings in tooling costs.
   D. Accuracy and repeatability.
   E. Almost total elimination of scrap.
   F. Lower capital investment.
   G. Less floor space.
   H. Savings in facility requirements.
   I. Reduced inspection time.
   J. Reduced flow time and inventory.
   K. Versatility in design.
   L. Improved production planning and control.
   M. Less skilled operators required.

V. Future Trends in CNC
   A. CNC and other automated manufacturing systems will replace a large portion of the human labor force.
   B. Improvement in CNC will lead to totally automated industrial settings.
   C. New improvements in CNC will lead to new manufacturing processes never before imagined.

MATERIALS FOR STUDENTS

- Vocabulary Worksheet
- CNC system
- Computer
- CNC systems manual

SUGGESTED STUDENT ACTIVITIES

Use appropriate computer program in Appendix A or other software package.

1. Have students examine a machine tool (drill press, lathe) and describe the types of commands that would be necessary to operate it if it were a CNC machine. Have students make a model of the syntax of a language to control a CNC machine (move right, move left, move up, etc.).

2. Have students construct a small servomechanism model and demonstrate how feedback controls the servomechanism.
3. Have students generate a graph showing (1) the rise of labor costs, (2) the falling price of microprocessors, and (3) the availability of other automated equipment (CAD, robots). What conclusions about the economic feasibility of automated factories do they come up with?
4. Have students write a computer simulation of the adaptive control process. What process variables are needed to run an adaptive control process (weight, flexibility, vibration, etc.)?

Vocabulary Worksheet

1. computer numerical control
2. numerical control
3. adaptive control
4. G-functions
5. M-functions
6. assembly language
7. FORTH
8. sensors
9. absolute system
10. incremental system
11. servomechanism
12. point-to-point control
13. contour control

TEST

Unit 6: Computer Numerical Control (CNC)

Directions: Read each statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank provided.

Example: __C__ 21. The class you are now attending is—
A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. NC technology is less than ___ years old.
A. 25
B. 40
C. 15
D. 30

___ 2. For input, an NC uses a—
A. paper tape
B. magnetic tape
C. card reader
D. diskette

___ 3. In an incremental system, each measurement is based on—
A. one reference point
B. operator input
C. servomechanism
D. the previous location

___ 4. Process variables are measured by a system called—
A. feedback
B. X and Y variables
C. adaptive control
D. quality control

___ 5. An example of a servomechanism would be—
A. a hammer
B. power brakes on a car
C. an electric motor
D. a screwdriver

___ 6. One factor that made CNC more economically feasible was—
A. inflation
B. cheap labor
C. rising computer costs
D. rising labor costs

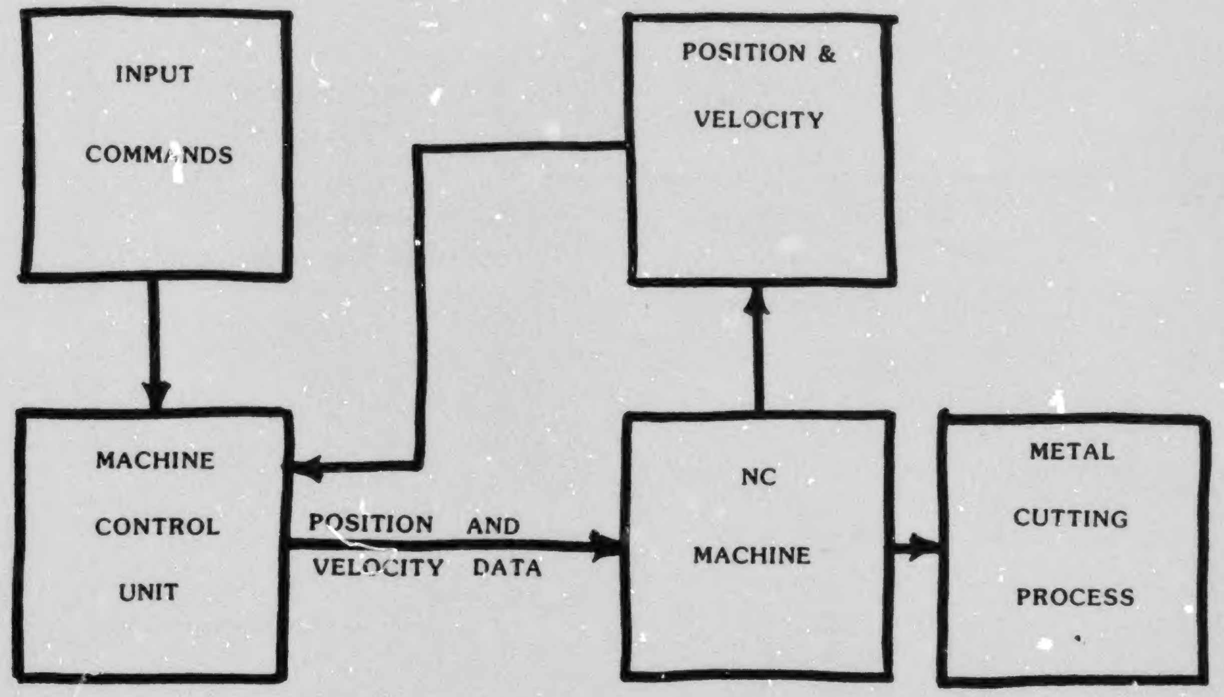
WHAT IS NC?

THE ELECTRONICS INDUSTRIES ASSOCIATION DEFINES NUMERICAL CONTROL (NC) AS A SYSTEM IN WHICH ACTIONS ARE CONTROLLED BY THE DIRECT INSERTION OF NUMERICAL DATA AT SOME POINT. THE SYSTEM MUST AUTOMATICALLY INTREPRET AT LEAST SOME PORTION OF THIS DATA.

WHAT IS CNC?

A COMPUTER NUMERICAL CONTROL (CNC) SYSTEM USES COMPUTER PROGRAMS STORED IN ITS STORAGE AREA OR IN A CENTRALLY LOCATED MAIN COMPUTER. THIS INFORMATION IS PASSED TO THE MACHINE'S CONTROL UNIT. THE CONTROL UNIT PROCESSES EACH COMMAND IN TURN, LIKE THE NC SYSTEM, CNC USES FEEDBACK DATA TO CHECK ITS OPERATIONS AND ADJUST IF NECESSARY.

HOW NC WORKS



INPUT COMMANDS

POSITION & VELOCITY

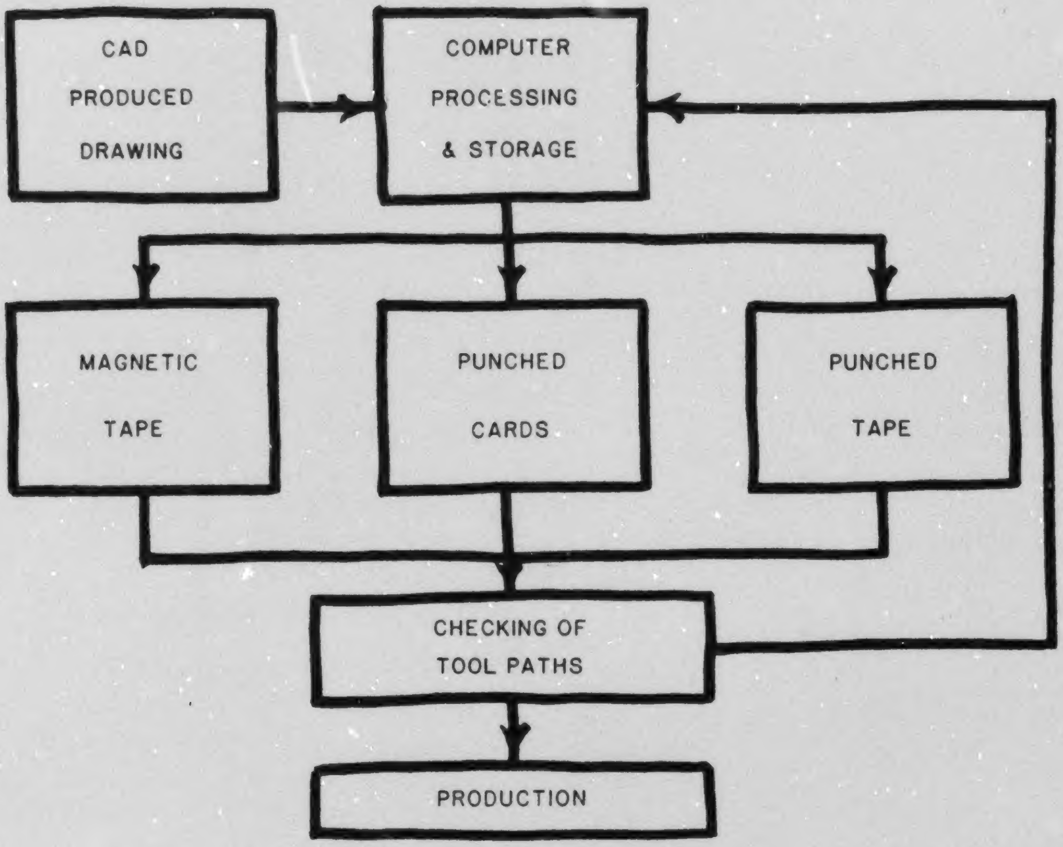
MACHINE CONTROL UNIT

POSITION AND VELOCITY DATA

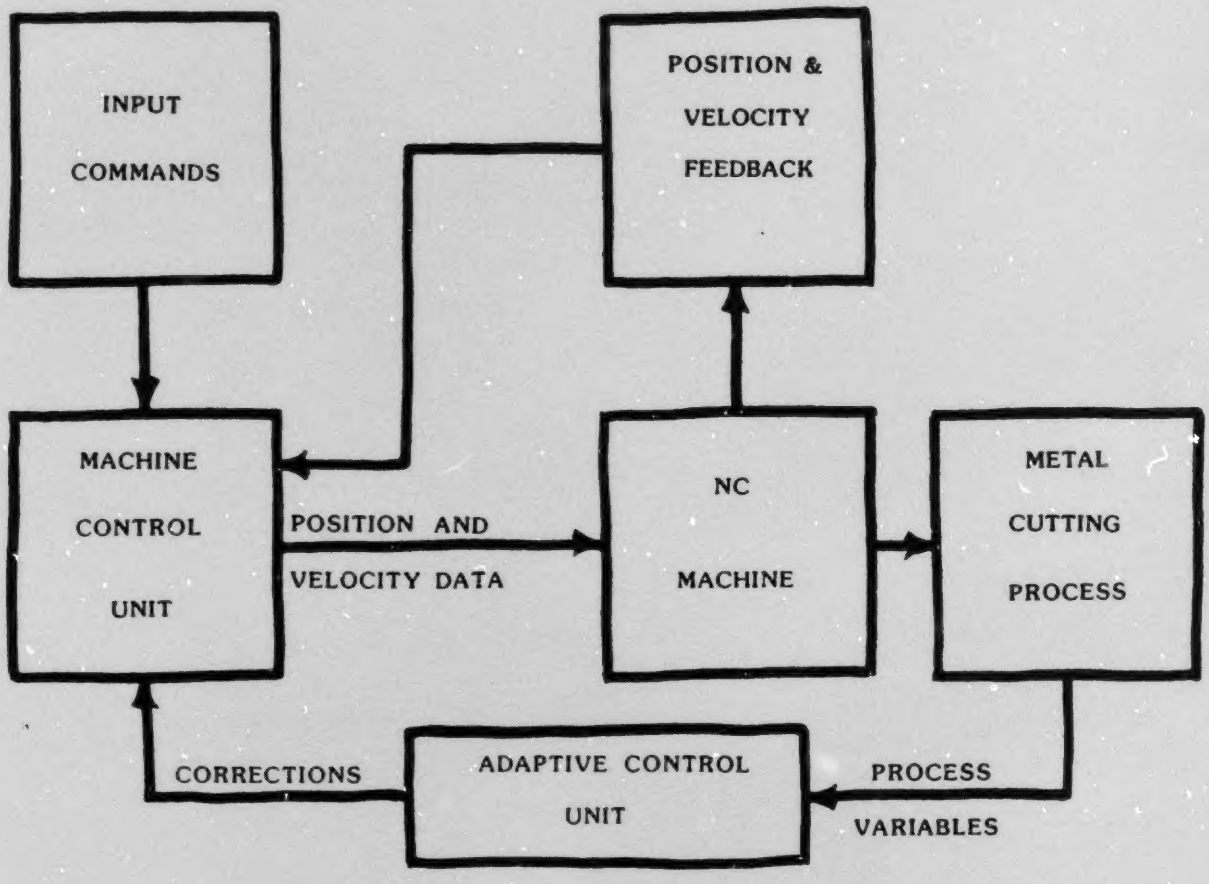
NC MACHINE

METAL CUTTING PROCESS

HOW CNC WORKS


CAD PRODUCED DRAWING
COMPUTER PROCESSING & STORAGE
MAGNETIC TAPE
PUNCHED CARDS
PUNCHED TAPE
CHECKING OF TOOL PATHS
PRODUCTION

ADAPTIVE CONTROL SYSTEM


INPUT COMMANDS
POSITION & VELOCITY FEEDBACK
MACHINE CONTROL UNIT
POSITION AND VELOCITY DATA
NC MACHINE
METAL CUTTING PROCESS
CORRECTIONS
ADAPTIVE CONTROL UNIT
PROCESS VARIABLES

TYPES OF CONTROL

POINT-TO-POINT

THIS TYPE OF CONTROL DEALS WITH EQUIPMENT THAT PERFORMS OPERATIONS AT A SPECIFIC POSITION AND IT DOES NOT AFFECT THE WORK-PIECE WHEN MOVING FROM POINT TO POINT.

CONTOUR

UNLIKE POINT-TO-POINT CONTROL, CONTOUR CONTROL CUTS CONTINUALLY ALONG A PRESCRIBED PATH AND THE WORK-PIECE IS AFFECTED BY ITS POSITION.

G-FUNCTIONS

THESE FUNCTIONS PREPARE THE CONTROL SYSTEM FOR INFORMATION THAT IS TO FOLLOW IN THE BLOCK.

M-FUNCTIONS

THESE FUNCTIONS GIVE MISCELLANEOUS FUNCTIONS FOR SPECIFIC OPERATIONS.

ADVANTAGES OF NC AND CNC

1. REDUCTION OF FLOOR-TO-FLOOR PRODUCTION TIME.
2. SAVINGS IN SHEET METAL FABRICATION AND MACHINING TIME.
3. SAVINGS IN TOOLING COST.
4. ACCURACY AND REPEATABILITY.
5. ALMOST TOTAL ELIMINATION OF SCRAP.
6. LOWER CAPITAL INVESTMENT.
7. LESS FLOOR SPACE.
8. SAVINGS IN FACILITY REQUIREMENTS.
9. REDUCED INSPECTION TIME.
10. REDUCED FLOW TIME AND INVENTORY.
11. VERSATILITY IN DESIGN.
12. IMPROVED PRODUCTION PLANNING AND CONTROL.
13. LESS SKILLED OPERATORS REQUIRED.

7

Robotics

OBJECTIVES

After students have covered the material in this unit, they should be able to—

1. define the word **robot** adequately;
2. identify the three forms of power used in robotics;
3. identify the major parts of the robot;
4. identify the four robot arm coordinates;
5. be familiar with the characteristics essential to all robots;
6. be familiar with the types of manipulators found in a robot;
7. operate a robot through a computer;
8. gain an understanding of why the robot is replacing humans in many areas of industry; and
9. identify the advantages and disadvantages of robotic installations in various technological settings.

KEY WORDS: VOCABULARY

The words listed below may be new to students studying computer applications. Teachers should help students understand these words as they are used in this topic of study.

robot
manipulator
controller
Cartesian coordinate
cylindrical coordinate
polar coordinate
revolute coordinate
memory
actuation
hydraulic
pneumatic
servo-controlled
stepper motor
degrees of freedom
component

gripper
end effector
circuitry
electronic computer
repeatability
efficiency
interface
positioning
numerical control
automation
prototype
artificial intelligence
jigs and fixtures
work envelope

TEACHING AIDS

- Robot arm models
- Audiovisual pens
- Magazines
- Newspaper clippings
- Robot
- Computer
- Film and/or slide series
- Overhead projector
- Test Key: 1-B, 2-D, 3-C, 4-A, 5-D, 6-B, 7-B
- Transparencies: You will find transparencies CA7-1 through CA7-6 at the end of this unit. If you wish, these masters may be duplicated in quantity and given as handouts to students while they are studying different aspects of this unit.
  CA7-1: Definition of a Robot

CA7-2: The Three Laws of Robotics
CA7-3: Robot Coordinates
CA7-4: Uses of Robots
CA7-5: Sample End Effectors
CA7-6: Hand (End Effectors)

SUGGESTED REFERENCES

Books

Amber, G. H., and Amber, P. S. Anatomy of Automation. Englewood Cliffs, N.J.: Prentice-Hall, 1962.

Asimov, Isaac. I, Robot. New York: Doubleday and Co., 1950.

Capek, Karel. R. U. R. (Rossum's Universal Robots). New York: Doubleday, Page, and Co., 1923. (a play)

Engleberger, Joseph F. Robotics in Practice. American Management Association, 1980.

Foster, D. Modern Automation. London: Sir Isaac Pitman and Sons, 1963.

Krasnoff, Barbara. Robots: Reel to Reel. New York: Acro Publishing Co., 1977.

Lundstrom, G., Glemme, B., and Rooks, B. W. Industrial Robots-Gripper Review. Bedford, England: International Fluidics Services, 1977.

Susnjara, Ken. A Manager's Guide to Industrial Robots. 1982.

Tanner, William R., ed. Industrial Robots. Dearborn, Mich.: Society of Manufacturing Engineers, 1979.

Periodicals

Computerized Manufacturing. Bimonthly. Technical Database, Conroe, Texas.

High Technology. Bimonthly. Technology Publishing Co., Boulder, Colorado.

The Industrial Robot. Quarterly. International Fluidics Services, Ltd., Carlton, Bedford, England.

Omni. Monthly. Omni Publications International, Ltd., New York.

Popular Science.

Robot. Quarterly. Japan Industrial Robot Association, Tokyo, Japan.

Robotics Age. Quarterly. Robotics Publishing Corp., La Canada, California.

Robotics Today. Quarterly. Society of Manufacturing Engineers, Dearborn, Michigan.

Science Digest. Monthly. Hearst Corporation, New York.

SENTENCE OUTLINE

I. Definition of a Robot **(Transparency CA7-1)**
   A. Karel Capek defined robots as humanoid machines constructed to perform obediently in the service of humans.
   B. Webster's defines a robot as an automatic apparatus or device that performs functions ordinarily ascribed to human beings or operates with what appears to be almost human intelligence.
   C. The Japanese define an "industrial robot" as an all-purpose machine, equipped with a memory and appropriate mechanism to automatically perform motions in replacing human labor.
   D. The Robot Institute of America defines a robot as a programmable, multifunctional manipulator designed to move material, parts, tools, or specialized devices through variable programmed motions for the performance of a variety of tasks.

II. The History of Robotics
   A. Karel Capek is credited with giving us the word "robot."
      1. Robots entered the English vocabulary with the translation of Capek's play "R.U.R. (Rossum's Universal Robots)" in 1923.
      2. In Capek's native Czech language, the word "robot" simply meant a worker.

   3. In the play, robots were the humanoid creations of Rossum and his son, constructed in the hope they would perform obediently in the service of humans.

B. Science fiction authors and illustrators tended to villainize robots.
   1. The popular conception of a robot became that of a mechanical person, crammed full of near-miraculous components and capable of clumsy imitations of human actions and speech.
   2. They were generally thought to combine superhuman strength and subhuman intelligence.
   3. Robots were often endowed with sinister intentions, so that the specter of a robot army marching against humankind has been a popular recurring theme in science fiction up to the present.

C. Isaac Asimov envisioned robots in a happier light, coined the word "robotics," and provided all roboticists with an ethic.
   1. In 1939, while still a teenager, Asimov began to write and publish a series of stories about robots.
   2. Asimov's robots, for the first time in science fiction, were pictured as having been deliberately engineered to do their job safely.
   3. In his stories, he gave roboticists the wisdom to design robots that contained fail-safe control circuitry to ensure their always "keeping their place."
   4. In 1942, Asimov formulated the three laws of robotics. **(Handout No. 1 and Transparency CA7-2)**
      a. A robot must not harm a human being nor, through inaction, allow one to come to harm.
      b. A robot must always obey human beings, unless that is in conflict with the first law.
      c. A robot must protect itself from harm unless that is in conflict with the first or second law.

D. The actual use of robots in the industrial environment developed slowly but was greatly boosted by the development of the electronic computer. **(Handout No. 2)**
   1. World War II showed us the need for faster and more efficient manufacturing techniques.
   2. In 1946, the Moore School of Electronic Engineers developed the first all-electronic computer.
   3. In 1949, the U.S. Air Force hired John T. Parsons, an experimenter in the numerical control of machinery, to help them develop new automation procedures.
   4. In 1952, the Massachusetts Institute of Technology subcontracted with Parsons and built a prototype one-axis numerically controlled machine.
   5. Computer numerical control (CNC) machinery continued to show progress through the 1950s.
   6. The first actual industrial robot was installed in 1961 by Unimation, Inc., to tend a die-casting machine.
   7. In the 1960s, there were many tentative and, for the most part, abortive attempts at developing competitive robots.
   8. No manufacturer or country was able to assume the early lead in robotics.
   9. By the 1970s, the artificial intelligence community had brought much attention to robotics.
   10. The Japanese now became very enthusiastic and formed the Japan Industrial Robot Association (JIRA) in 1971.
   11. In 1973, Warnecke and Schrafft of Stuttgart University wrote Industrie Roboter, in which they listed 71 firms as being developers of robots.
   12. The USA could not boast of enough committed manufacturers to form an association until 1975, when the Society of Manufacturing Engineers formed the Robot Institute of America (RIA).

III. Current Developments

- A. Don't expect all robots in industry to be humanoid in appearance, with blinking lights and an audible voice.
  1. Robots come in many shapes and sizes.
  2. Some are designed to handle only a few grams, while others can cope with as much as 1,000 Kg.
  3. Some are controlled by sophisticated computers, while others rely on simple mechanical stops and pegboard programming.
  4. Operating power can be electric, pneumatic, hydraulic, or any combination of the three.
  5. Arm coordinates can be one or any combination of the following: Cartesian, cylindrical, polar, or revolute. **(Transparency CA7-3)**
- B. Robots are replacing the human work force in many industrial jobs.
  1. Primarily, robots do simple and repetitive jobs more steadily, reliably, and more uncomplainingly than humans can. **(Transparency CA7-4)**
  2. The work force that is primarily being replaced is that of unskilled workers.
  3. This is because the unskilled worker is generally required to learn only one sequence of operations, which is then performed over and over again.
  4. In most cases, a robot can perform the same tasks more reliably.
- C. Some of the more obvious reasons contributing to the replacing of human workers by robots are:
  1. Robots can outperform humans in hostile working environments where noise, vibration, smells, or danger act adversely on the physiological system.
  2. Robots do not have to stop to eat, take coffee breaks, or change shifts.
  3. Robots do not get tired, need sleep, or have a family to go home to.
  4. Robots can be designed with much more muscle power than humans have.
  5. In many cases, a robot can be programmed to replace more than one human worker, making the robot very cost-effective.
- D. Selecting a robot to replace a human worker at any work station requires certain specifications.
  1. By considering what a person has to do at a work station, it is possible to devise a list of corresponding characteristics that a robot must possess if it is going to replace that person.
  2. A specification for an industrial robot obviously must exclude any requirement that cannot be achieved in practice. **(Handout No. 3)**
  3. Every feature specified must be within the scope of contemporary engineering knowledge and practice.
  4. The replacement robot must not be too big, too heavy, or too expensive.
  5. It must be reliable and capable of doing its job for hour after hour with little attention and no mechanical problems.
  6. The robot must have some system of programming by a human teacher.
  7. It should have a memory system to enable the robot to operate in the absence of the programmer.
- E. A summary of essential characteristics for a good industrial robot follows: **(Handout No. 4)**
  1. a hand, capable of gripping and releasing the workpiece;
  2. an arm, which can move the hand in three planes;
  3. a wrist for the arm, with articulations that allow the hand/wrist assembly to be aimed anywhere in the workpiece;
  4. sufficient muscle power to accomplish the work;
  5. positioning repeatability to 0.3 mm;
  6. manual controls, with which a person can operate all robot limb functions;
  7. a built-in memory that can learn the human teacher's instructions;
  8. automatic systems that enable the memory to control operations in the absence of the human teacher;
  9. a speed of operation at least as fast as a person;

10. a library of programs that can be selected at will, allowing the robot to be switched back to operations that it has been taught in the past;
11. facilities for safety and process interlocks with the plant or machinery to be operated;
12. a computer-compatible interface;
13. reliability of at least 400 hours MTBF (mean time between failure) in the actual working environment;
14. configuration that allows easy maintenance, with quick access and interchangeability of parts in the event of breakdown, aided by self-diagnostic routines.

F. The way that a robot can move is called **robot actuation.**
   1. There are three types of arm actuation (movement): hydraulic, pneumatic, and electrical.
   2. The first two require the use of large, expensive, and noisy pumps and compressors.
   3. Therefore, they (hydraulic and pneumatic) are for heavy-duty, factory-type applications where physical strength is required to manipulate heavy objects.
   4. The electrical approach can essentially be divided into two areas: heavy-duty (factory) and mobile robots.
   5. In the low-power, electrically actuated mobile robot, movement is via fractional horsepower DC motors, which limits its "work" power to light loads.
   6. Electric robots powered by batteries are free from the restraints of power system cabling, allowing them to be mobile.

G. There are four major robot arm configurations that dictate the coordinate system used by the arm.
   1. These coordinate systems include Cartesian, cylindrical, polar, and revolute.
   2. The particular coordinate system used dictates the shape of the "work envelope" in which the end of the arm and its attached manipulator can be placed.
   3. The Cartesian system can produce a work envelope shaped like a cube.
   4. The cylindrical coordinate system work area will be shaped like a thick cylinder.
   5. The polar coordinate system produces a work envelope shaped like half a sphere.
   6. The revolute approach can almost imitate the human arm.
   7. The number of intricate motions that a robot arm can perform is determined by the number of axes it has.
   8. These are often called "degrees of freedom."
   9. Most industrial robots have three to five degrees of freedom to perform their specified task.
   10. The greater the number of degrees of freedom, the more complex tasks the robot can perform.

H. Many tools can be attached to the end of the robot arm.
   1. Many kinds of **end effectors** (work-handling mechanisms) are used in robotics. **(Transparencies CA7-5 and CA7-6)**
   2. Vacuum cups can be used to pick up flat objects and place them where needed.
   3. Mechanical grippers are similar to human hands in function.
   4. Electromagnets can be used to pick up and place ferrous objects.
   5. Nutdrivers or screwdrivers are used by robots to use threaded fasteners.
   6. Special nuts and bolts have been designed to aid robots in placing and starting threaded fasteners.
   7. General-purpose power tools, such as grinders, drills, paint guns, and saws, can be attached to robot arms.

I. A robot can be operated manually by a human worker.

1. A robot can work on its own if it has a memory.
2. This memory is usually sorted in a computer.
3. This memory and the computer link with the robot is called the **controller.**
4. The controller initiates and terminates manipulator motions.
5. The controller stores position and sequence data in memory.
6. The controller provides an interface between the robot and the outside world.
7. The controller provides a way for the robot to learn and remember.

J. Robots have many types of grippers to do different kinds of jobs.

1. These grippers are also referred to as end effectors and hands.
2. The hand or gripping device is usually attached to the end of the robot's manipulator (arm).
3. The functions of the end effector include grasping, pushing and pulling, twisting, using tools, and performing insertions and assembly.
4. End effectors can be mechanical, vacuum, or magnetically operated, can be a snare device, or have some exotic configuration.
5. The design of an end effector is determined by the shapes of the objects it has to grasp.
6. Most end effectors are simply some gripping or clamping device.

IV. Future Attributes and Capabilities **(Handout No. 5)**

A. When we think about the attributes or qualities that will be required of future robots, we must consider the technological demands and just how urgent the need is for a particular attribute.

1. Robots have already been programmed to "see."
2. They presently "see" in two dimensions, but soon it will be in three dimensions.
3. The robot will be able to recognize an object by just its silhouette.
    a. First, a picture of the object will be programmed into the robot's memory.
    b. The robot will "see" the object later through a video camera or other photographic equipment and mentally record a picture of it.
    c. It will then go back to its memory bank to match what it has "seen" with what is already in its memory.
4. There are currently three basic approaches to three-dimensional vision for robots.
    a. Range finding is the first of these three.
    b. The second approach is "structured light" techniques.
        (1) Both the range-finding and "structured light" techniques are easy to implement and therefore close to commercial realization.
        (2) Both techniques rely on depth cues from the way light or radiation (like sound waves from an X-ray) reflect off of the surface of an object.
        (3) The range-finding system typically times the reflection of a laser beam to the object and back again to measure its distance, similar to radar.
    c. Binocular vision is the third and most promising form of robot vision for the future, as it uses video cameras and is the most similar to actual human sight.
5. Vision will allow a robot to recognize things and also to determine where things are.
6. These two important areas are listed as **recognition data** and **orientation data.**
7. In the factory environment, orientation data is much more important.
8. A human can look into a basket of parts and pick them out one at a time and orient them for placement in a secondary operation.
9. However, this human's work has so far eluded the artificial intelligence community.

10. If you have a bin full of identical parts, how do you direct the robot to pick them out one at a time in oriented fashion?
11. This problem has seen the most intense research and development efforts.
12. Pattern recognition researchers have devoted their attentions to recognition, which has become extremely useful in medical instrumentation and in the business paperwork world.
13. In the factory, however, recognition is not the key because production control departments will be able to tell people or robots where parts are located and where to deliver them.
14. Presently, experimental vision systems are pretty good at defining the position of an individual black part on a white background.
15. However, the factory world is not black and white, but tends to have subtle gradations between the two.
16. Robots with sophisticated vision that can interpret sixteen levels of gray in a scene will be commonplace by the end of the decade.
17. As robots are built with better vision, they will be able to move around objects in their work area.

B. If tactile-sensing technology moves faster than vision technology, it could be a more important advancement for early future robots to possess.
1. A robot with tactile sense could use its capabilities to recognize parts just as most humans can detect when something is in a darkened room.
2. The tactile sense would tell the robot somehow what is going on during the interaction of parts of tools in its hand with the workpiece before it.
3. The theory behind sensing obstacles in its way involves proximity detectors.
4. These detectors will be sonar, electronic, or some other item developed for detection purposes.
5. They will determine when the robot is getting close to an object and cause it to stop or go around the obstacle, according to its programming.

C. Both vision and tactile sensing are not absolutes.

D. There are many industrial jobs that are really much better handled by a two-handled operator. Thus, choreography is needed that will enable two robot arms to work together just as do the two arms of human assembly workers.

E. Although most industrial robots do their work in place, as do their human counterparts, there are jobs for roving operators and a need for robots that can move.

F. We need to produce robots that match the human physique, which may be easier than redesigning manufacturing plants matched to the spatial demands of current-day robots.

G. Although energy use is not yet an important issue in robotics, it could become one. We must work to produce robots that are more energy efficient.

H. Improvements are needed to produce a more universal gripper that could cope with a wider range of gripping activities.

I. It will be very advantageous for the human boss to be able to use plain English to instruct a robot as to its ongoing work.

J. In addition, the robot could respond to the boss with synthesized speech to explain its view of the work situation, or to explain internal ailments that need service attention.

K. A self-diagnostic software package will be needed that will pinpoint a deficiency under any failure condition and direct the human service staff in efficient methods of repair.

L. As robots and humans work side by side, safety must be built in to the robot.

M. The robot plus all its accessory attributes must be just as easily economically justified as is any other piece of cost-saving equipment.

N. A great advantage of the robot of the future will be its use in dangerous situations.

1. In the area of radiation, the robot can be taken into places where humans could not survive.
2. In the case of fire and other disasters, the robot could be programmed for rescue and built to withstand extreme heat and cold.
3. The space industry could greatly benefit from the use of robots.
   a. Robots could be transported to other planets to perform scientific research.
   b. Robots could be used to perform dangerous satellite repair work, being operated from within a space capsule or even from earth.
4. Future undersea scientific research and possibly undersea farming and mining could be performed for great time periods by robots.

O. In the future, robots will be playing an even greater role in our industry.
   1. It is estimated that, by 1988, robots or other forms of automation will replace half of the human labor in small component industry.
   2. The sensitivity of robots in industry will be as much as human hands have.
   3. "Robot assembly systems," which are clusters of robots working many tasks at once at the same place, will also be a major part of industry.
   4. Although Japan is presently the leading producer of robots, it is predicted that in the near future many more nations will be in competition with them, including the United States.
   5. An "explosive" growth is expected from robots in the near future.
      a. Because of this growth, there is much concern about unemployment.
      b. Robots may replace humans in many areas. However, humans will still be needed for programming and troubleshooting.
      c. In order to compete with the Japanese, we must use robots.
      d. Totally automated companies will be less affected by employment trends.

MATERIALS FOR STUDENTS

- Vocabulary Worksheet
- Handouts No. 1 through No. 5

SUGGESTED STUDENT ACTIVITIES

Use appropriate computer program in Appendix A or other software package.

1. Take a field trip to an industry that makes use of robots or invite a speaker from a company that uses robots to talk to your class.
2. Have students go to the school library or public library and write a report on an aspect of robotics.
3. Have students operate a computer to control a robot.
4. Have students program a robot to do a task using a teach pendant.
5. Have students design and construct a robot arm model.
6. Have students work in small groups to create posters showing the uses of a robotic arm and/or computer.
7. Have students make a list of how they could use a robot arm at home.
8. Have students make a list of what they think robots will be doing in the future.
9. Have students design and create jigs and fixtures to hold workpieces for a robot.
10. Divide students into small groups, and assign each group an individual job (moving materials, assembly line operation) for which they must make a rough sketch of a robot that could perform the job.
11. Conduct laboratory activities, based on robotic hardware and software controlling and moving the robot.

Vocabulary Worksheet

1. robot
2. manipulator
3. controller
4. Cartesian coordinate
5. cylindrical coordinate
6. polar coordinate
7. revolute coordinate
8. memory
9. actuation
10. hydraulic
11. pneumatic
12. servo-controller
13. stepper motor
14. degrees of freedom
15. component
16. gripper
17. circuitry
18. electronic computer
19. repeatability
20. end effector
21. efficiency
22. interface
23. positioning
24. numerical control
25. automation
26. prototype
27. artificial intelligence
28. jigs and fixtures
29. work envelope

TEST

Unit 7: Robotics

Directions: Read eech statement carefully. Select the one word or phrase that correctly answers or completes the statement, and write the appropriate letter in the blank.

Example: __C__ 21. The class you are now attending is—
A. American Government
B. Language Arts
C. Industrial Arts
D. General Science

___ 1. The part of a robot that maneuvers objects is called a—
A. hand
B. manipulator
C. grasper
D. forklift

___ 2. All of the points in space that can be reached by the robot are called the—
A. area
B. field
C. mechanical arm
D. work envelope

___ 3. The device that functions as the robot's hand is called the—
A. tool
B. servomechanism
C. end effector
D. compressor

___ 4. The major and minor axes of the robot operate using—
A. coordinate systems
B. operating systems
C. telecommunications
D. database systems

___ 5. A robot's hand is ______________________________ other robot hands.
A. similar to
B. dependent on
C. not compatible with
D. interchangeable with

___ 6. One source of power for robots is—
A. nuclear power
B. hydraulic pumps
C. solar energy
D. natural gas

___ 7. The advantage that an electrically powered robot has over other robots is—
A. speed
B. dependability
C. mobility
D. accuracy

HANDOUT NO. 1

The Three Laws of Robotics

1. A robot must not harm a human being nor, through inaction, allow one to come to harm.

2. A robot must always obey human beings, unless that is in conflict with the first law.

3. A robot must protect itself from harm, unless that is in conflict with the first or second laws.

HANDOUT NO. 2

Disciplines Useful to Robotics

Kinematics
Dynamics
Servo design
Fluid power
Digital electronics
Analog electronics
Computer structure
Integrated-circuit design
Computer software
Cybernetics
Automation technology
Numerical control
System engineering
Rotating machinery
Gear design
Structural engineering
Tribology
Metallurgy
Metrology
Sensory instrumentation
Character recognition
Industrial engineering
Manufacturing engineering
Physiology
Bionics
Psychology
Sociology
Economics
Futuristics
Oceanography

HANDOUT NO. 3

Robot Qualities Already Commercially Available

1. Work space command with six infinitely controllable articulations between the robot base and its hand extremity.
2. Teach and playback facilities—realizing fast, instinctive programming.
3. Local and library memories of any size desired.
4. Random program selection possible by external stimuli.
5. Positioning accuracy repeatable to within 0.3 mm.
6. Weight-handling capability up to 150 kilos.
7. Point-to-point control and continuous path control, possibly intermixed in one robot.
8. Synchronization with moving workpieces.
9. Interface allowing compatibility with a computer.
10. Palletizing and depalletizing capability.
11. High reliability—with not less than 400 hours MTBF.
12. All the capabilities available for a price that allows purchase and operation within the traditionally accepted rules for economic justification of any new equipment.

HANDOUT NO. 4

Robot Characteristics

1. A hand, capable of gripping and releasing the workpiece.
2. An arm, which can move the hand in three planes.
3. A wrist for the arm, with articulations that allow the hand/wrist assembly to be aimed anywhere in the workpiece.
4. Sufficient muscle power to accomplish the work.
5. Positioning repeatability to 0.3 mm.
6. Manual controls, with which a person can operate all robot limb functions.
7. A built-in memory that can learn the human teacher's instructions.
8. Automatic systems that enable the memory to control operations in the absence of the human teacher.
9. A speed of operation that is at least as fast as a person.
10. A library of programs that can be selected at will, allowing the robot to be switched back to operations that it has been taught in the past.
11. Facilities for safety and process interlocks with the plant or machinery that is to be operated.
12. A computer-compatible interface.
13. Reliability of at least 400 hours MTBF (mean time between failure) in the actual working environment.
14. Configuration that allows easy maintenance, with quick access and interchangeability of parts in the event of breakdown, aided by self-diagnostic routines.

HANDOUT NO. 5

Robot Qualities Sought for the Future

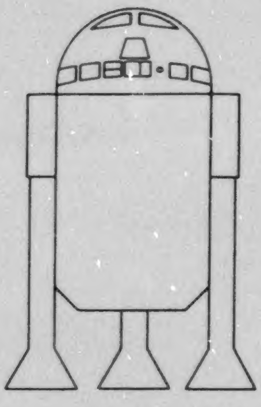
1. Rudimentary sense of vision to provide:
    a. recognition data
    b. orientation data
2. Tactile sensing giving:
    a. recognition data
    b. orientation data
    c. physical interaction data
3. Computer interpretation of the visual and tactile data.
4. Multiple appendage hand-to-hand coordination.
5. Computer-directed appendage trajectories.
6. Mobility.
7. Minimized spatial intrusion.
8. Energy-conserving musculature.
9. General-purpose hands.
10. Human-robot voice communications.
11. Total self-diagnostic fault tracing.
12. Inherent safety.
13. All the capabilities above available for a price that allows purchase and operation within the traditionally accepted rules for economic justification of any new equipment.

DEFINITION OF A ROBOT

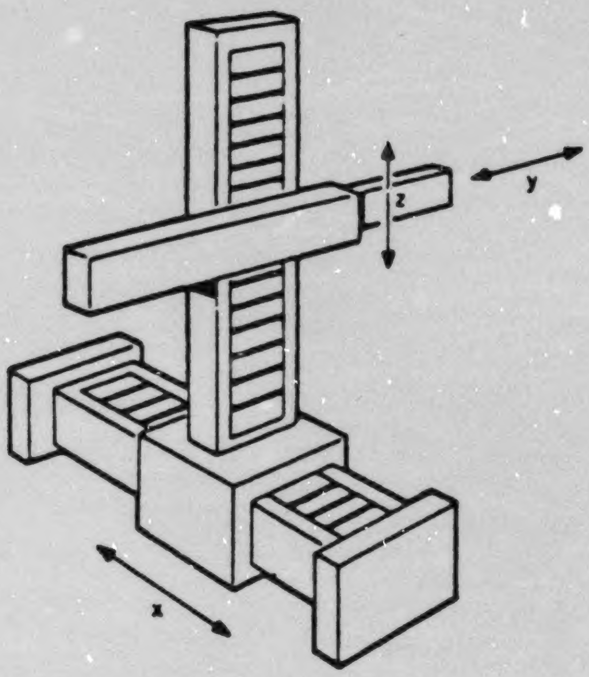
1. KAREL CAPEK DEFINED THE WORD "ROBOT" AS A HUMANOID MACHINE CONSTRUCTED TO PERFORM OBEDIENTLY IN THE SERVICE OF MAN.
2. WEBSTER'S DICTIONARY DEFINES A ROBOT AS AN AUTOMATIC APPARATUS OR DEVICE THAT PERFORMS FUNCTIONS ORDINARILY DESCRIBED TO HUMAN BEINGS OR OPERATES WITH WHAT APPEARS TO BE ALMOST HUMAN INTELLIGENCE.
3. THE JAPANESE DEFINITION OF AN "INDUSTRIAL" ROBOT IS AN ALL-PURPOSE MACHINE, EQUIPPED WITH A MEMORY AND APPROPRIATE MECHANISM TO AUTOMATICALLY PERFORM MOTIONS IN REPLACING HUMAN LABOR.
4. THE ROBOT INSTITUTE OF AMERICA DEFINES A ROBOT AS A PROGRAMMABLE, MULTIFUNCTIONAL, MANIPULATOR DESIGNED TO MOVE MATERIAL, PARTS, TOOLS, OR SPECIALIZED DEVICES, THROUGH VARIABLE PROGRAMMED MOTIONS FOR THE PERFORMANCE OF A VARIETY OF TASKS.

THE THREE LAWS OF ROBOTICS

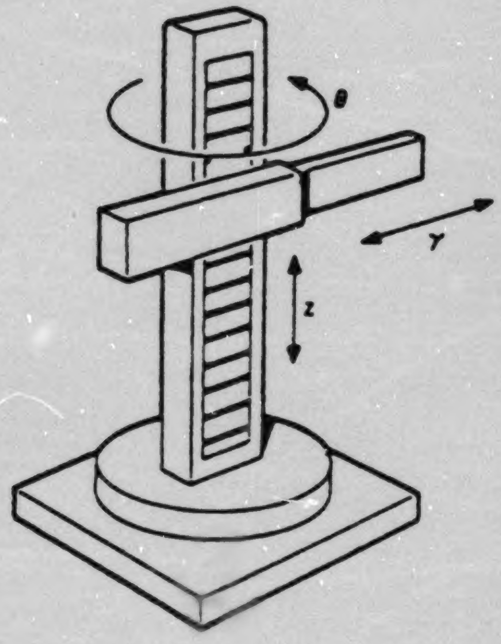
1. A ROBOT MUST NOT HARM A HUMAN BEING NOR, THROUGH INACTION, ALLOW ONE TO COME TO HARM.
2. A ROBOT MUST ALWAYS OBEY HUMAN BEINGS, UNLESS THAT IS IN CONFLICT WITH THE FIRST LAW.
3. A ROBOT MUST PROTECT ITSELF FROM HARM, UNLESS THAT IS IN CONFLICT WITH THE FIRST OR SECOND LAWS.



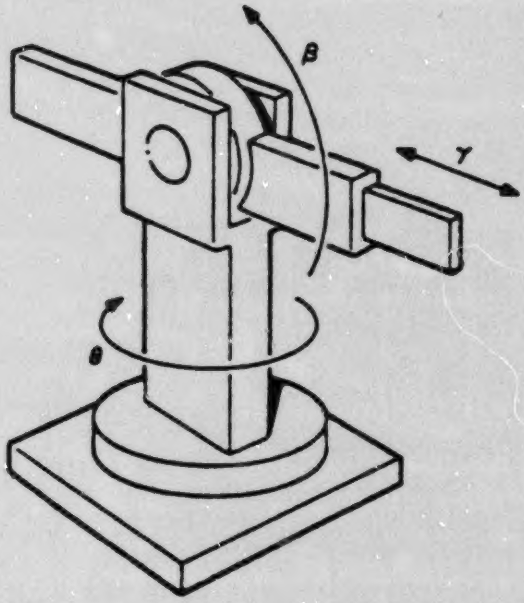
ROBOT COORDINATES



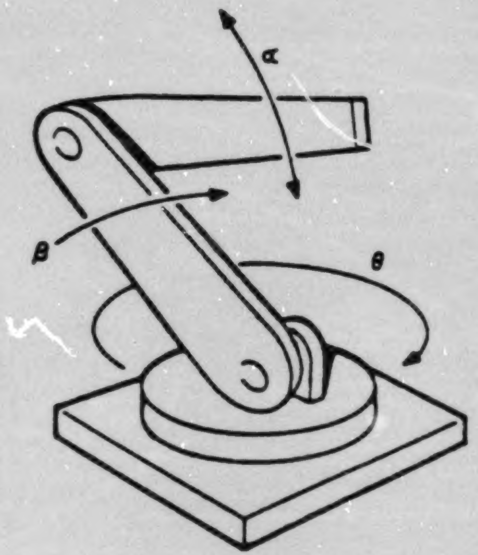
CARTESIAN COORDINATES



CYLINDRICAL COORDINATES

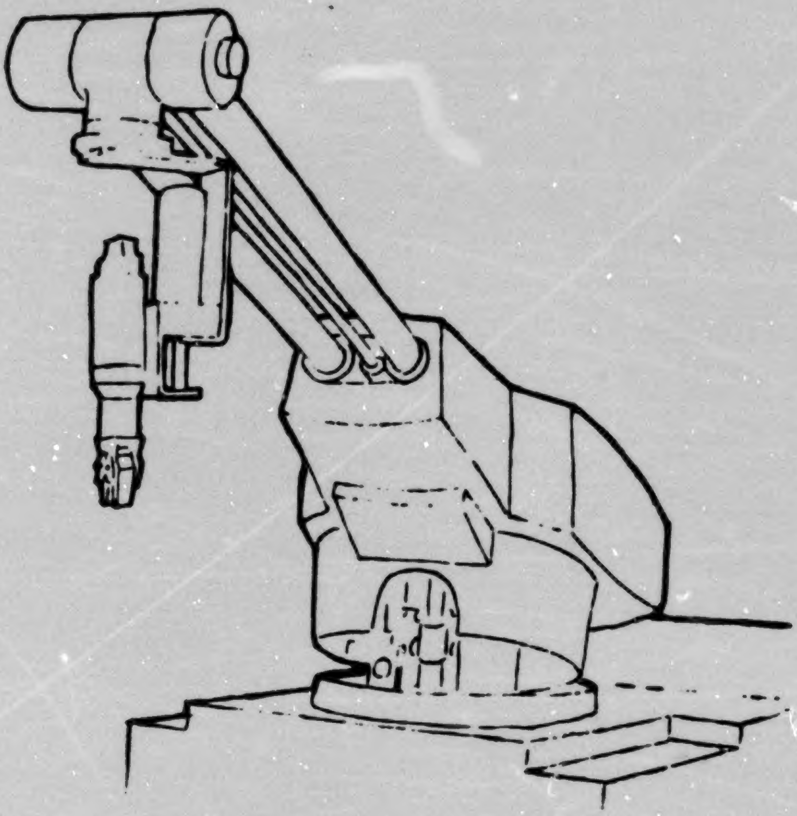


POLAR COORDINATES



REVOLUTE COORDINATES

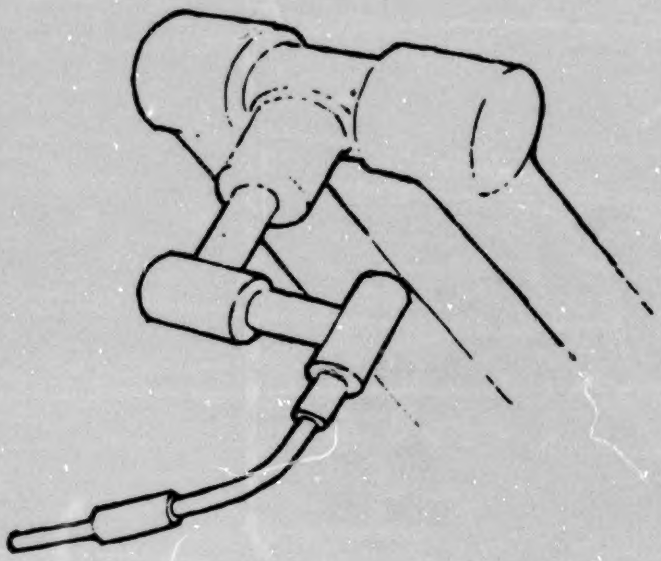
USES OF ROBOTS



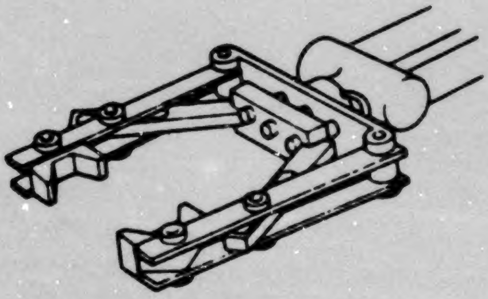
Robots don't just handle things—they do things too

If you think robots are only good for picking up widgets at point A and moving them to point B, think again. Armed with simple tools, robots become willing workers that will boost the value added in tiresome, everyday, repetitive operations.

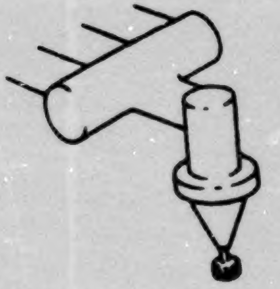
SAMPLE END EFFECTORS



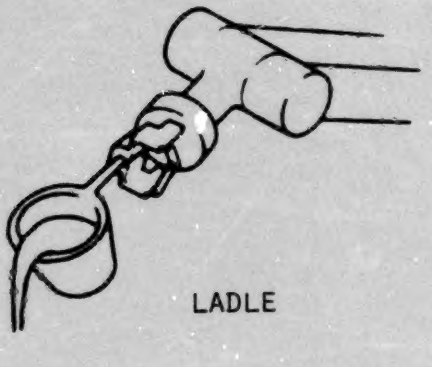
INERT GAS ARC WELDING TORCH



CAM OPERATED HAND

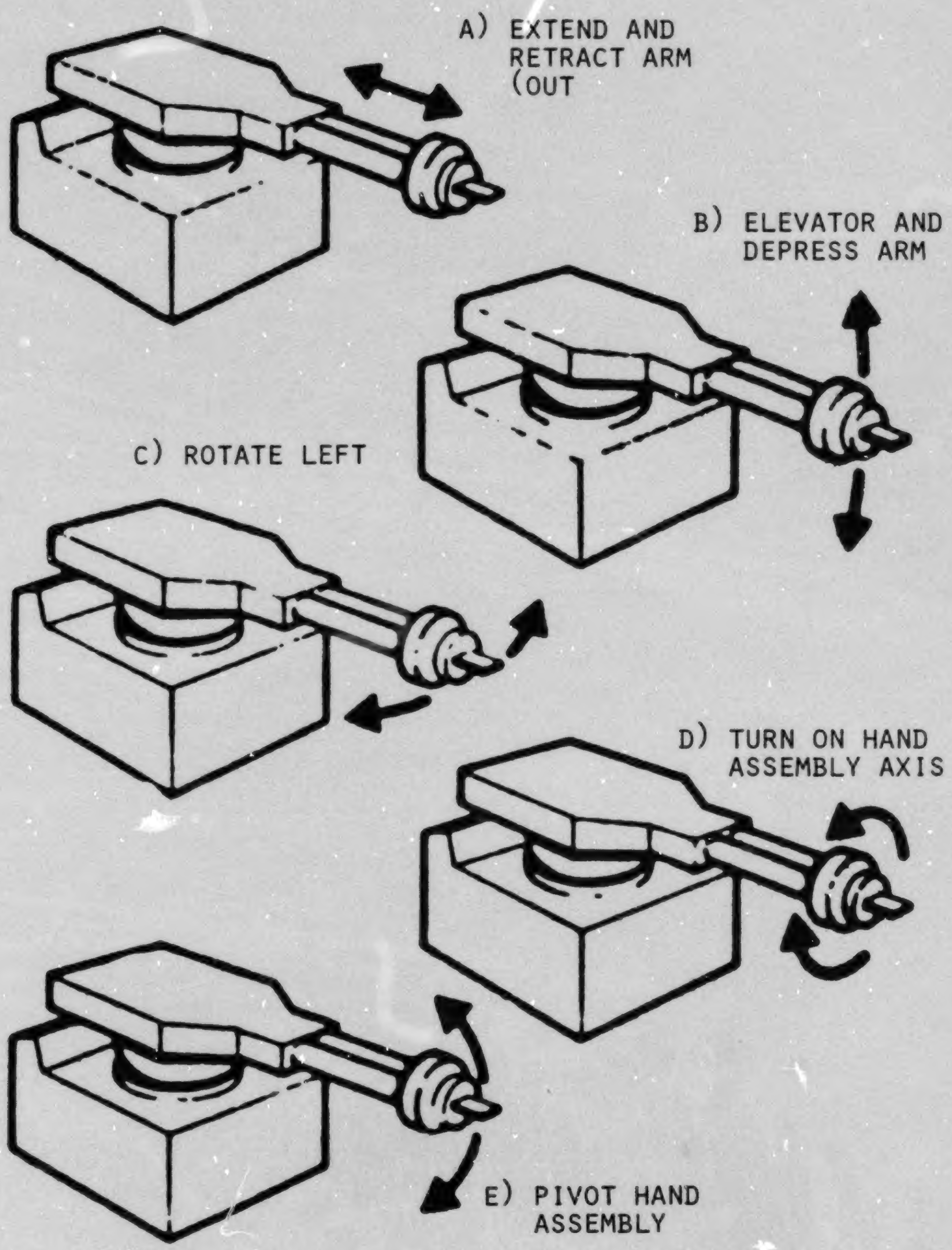


ROUTERS, SANDERS AND GRINDERS



LADLE

HAND (END EFFECTORS)



A) EXTEND AND RETRACT ARM (OUT

B) ELEVATOR AND DEPRESS ARM

C) ROTATE LEFT

D) TURN ON HAND ASSEMBLY AXIS

E) PIVOT HAND ASSEMBLY

Appendices

APPENDIX A: Computer Programs

The computer programs listed in this section have been developed by industrial arts teachers and teacher educators from across the country. All programs are in the public domain and may be copied. Since these programs have been developed by many people, we cannot guarantee that all of them will work. Likewise, when you type in a program, check to make sure that you have entered the data correctly.

All programs listed in this section are available on disk from Extension Instruction and Materials Center. Computer programs are sold on a cost-recovery basis.

Extension Instruction and Materials Center also runs a computer software exchange network. As part of the network, the Center publishes a bimonthly newsletter reviewing commercially available computer programs and teacher-generated computer programs. Computer programs can be submitted for review in the newsletter and for distribution through our computer software exchange network.

GENERAL

- Metric conversion
- Inches to centimeters
- Inches to millimeters
- Feet to centimeters
- Feet to meters
- Yards to centimeters
- Yards to meters
- Miles to meters
- Miles to kilometers
- Centimeters to inches
- Centimeters to feet
- Meters to feet
- Meters to yards
- Kilometers to yards
- Kilometers to miles
- Gallons to liters
- Liters to gallons
- Fahrenheit to Celsius
- Celsius to Fahrenheit
- Conversion menu
- Checkbook
- Bell controller

ORGANIZATION AND MANAGEMENT

- Test score evaluation
- Supply inventory and accounts
- Recycling accounts file
- Class chore assignments
- Vocabulary drill

ENERGY TECHNOLOGY

- Resistor
- Resistor codes
- Rocket data
- Opto launch (controlled rocket launcher)
- Light-activated counter
- Light beam counter
- Traffic signal simulator
- Traffic signal controller
- Ohm's law
- Horsepower
- Temperature conversion

COMMUNICATIONS TECHNOLOGY

Photo dilution
Isometric
Define object
View object
Allocate menu
Plotter routine
Cabinet drawing routines

PRODUCTION TECHNOLOGY

Machine shop calculations
Roof estimation and cost
Concrete estimation and cost
Treasury bill
Interest on bonds
Continuous interest compound
Tax deduction
Present value of investment
Future value of investment
Depreciation switch
Internal rate of return
Mortgage amortization
Production and distribution
Stair calculator
Figuring length of common rafter
Board units
Board feet

```
>RUN
METRIC  CONVERSION

1---MILLIMETERS TO INCHES

2---CUBIC CENTEMETERS TO CUBIC INCHES

3---SQ. CM  TO  SQ. INCHES

4---SQ. METERS TO SQ. FEET

5---KILOGRAMS TO POUNDS

6---MILES TO KILOMETERS


S E L E C T   A   N U M B E R ? 5

ENTER THE NUMBER OF KILOGRAMS  ? 25

THE NUMBER OF POUNDS =   55.115558525

DO YOU WANT ANOTHER CALCULATION ?  YES = 1,  NO = 0?
^C
Break in 290
Ready

>LLIST
10 CLS
20 PRINT"                 METRIC  CONVERSION"
30 PRINT:PRINT
40 REM  BY J.R. MYCUE 1983
50 PRINT        "1---MILLIMETERS TO INCHES"
60 PRINT
70 PRINT        "2---CUBIC CENTEMETERS TO CUBIC INCHES"
80 PRINT
90 PRINT        "3---SQ. CM  TO  SQ. INCHES"
100 PRINT
110 PRINT       "4---SQ. METERS TO SQ. FEET"
120 PRINT
130 PRINT       "5---KILOGRAMS TO POUNDS"
140 PRINT
150 PRINT       "6---MILES TO KILOMETERS"
160 PRINT:PRINT
170 INPUT "S E L E C T   A   N U M B E R  " ; S
180 PRINT
190 IF S=1 THEN GOTO 250
200 IF S=2 THEN GOTO 320
210 IF S=3 THEN GOTO 370
220 IF S=4 THEN GOTO 420
230 IF S=5 THEN GOTO 470
240 IF S=6 THEN GOTO 520
250  INPUT "ENTER THE NUMBER OF MILLIMETERS TO BE CONVERTED";A
260  PRINT
270 PRINT "THE NUMBER OF INCHES =  ";A * .03937
```

```
280 PRINT
290 INPUT "DO YOU WANT ANOTHER CALCULATION ?   YES = 1,  NO = 0";X
300 IF X=1 THEN GOTO 10
310 IF X=0 THEN END
320 INPUT "ENTER THE NUMBER OF CUBIC CENTIMETERS   ";B
330 PRINT
340 PRINT "THE NUMBER OF CUBIC INCHES = ";B * .06102338
350 PRINT
360 GOTO 290
370 INPUT "ENTER THE NUMBER OF SQUARE CENTEMETERS  ";C
380 PRINT
390 PRINT " THE NUMBER OF SQUARE INCHES =  "; C*.15499969
400 PRINT
410 GOTO 290
420 INPUT "ENTER THE NUMBER OF SQUARE METERS  ";D
430 PRINT
440 PRINT "THE NUMBER OF SQUARE FEET =  "; D*10.76387
450 PRINT
460 GOTO 290
470 INPUT "ENTER THE NUMBER OF KILOGRAMS  ";E
480 PRINT
490 PRINT "THE NUMBER OF POUNDS =  ";E * 2.204622341
500 PRINT
510 GOTO 290
520 INPUT "ENTER THE NUMBER OF MILES  ";F
530 PRINT
540 PRINT "THE NUMBER OF KILOMETERS = "; F * 1.6093472
550 PRINT
560 GOTO 290
Ready
>
```

CONVERSIONS

The first set of programs we have are convertion programs. They convert from English measure to Metric. These are very simple and easy to type in programs.

The first program is "INCHES TO CENTIMETERS". This program converts inches to centimeters. While typing it in you do not have to type the "REM", or "REMARK", statements. They are there simply to let you know what the program is doing at a given point.

This program first reads in the number of inches to be converted. Then it converts them, and finally it prints out the convertion. For example, say you wanted to find out how many centimeters are in a yard strick. You would enter 36 for the number of inches and the program would output the convertion.

Here then is a sample run and a listing of the program.

```
LOAD INCHES TO CENTIMETERS,D1
]RUN

    ENTER THE NUMBER OF INCHES TO BE
CONVERTED TO CENTIMETERS, IN DECIMAL
FORM?36

    36 INCHES = 91.44 CENTIMETERS.


    A = ANOTHER   E = END

]LIST

10  REM CHANGE INCHES TO
20  REM CENTIMETERS.
30  REM
35  HOME : PRINT : PRINT : PRINT

40  REM INPUT # OF INCHES
50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF INCHES TO BE"
60  PRINT "CONVERTED TO CENTIMETE
     RS, IN DECIMAL"
65  PRINT "FORM";: INPUT I
70  REM CONVERT TO CENTIMETERS
80 C = I * 2.54
90  REM OUTPUT ANSWER
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)I;" INCHES = "
     ;C;" CENTIMETERS."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 35
160  END

]
```

The second program is "INCHES TO MM" (MM means milimeters). This program converts inches to milimeters. It first ask for the number of inches to be converted. Then it converts to milimeters, and finally it outputs the convertion. For example, say you have a six-inch ruler and you wanted to know how many milimeters are in the ruler. You would input 6 to the program and it would output the convertion to milimeters.

Here is a sample run and listing of the program.

```
LOAD INCHES TO MM
]RUN



    ENTER THE NUMBER OF INCHES TO BE
CONVERTED TO MM, IN DECIMAL FORM?6



    6 INCHES = 152.4 MILIMETERS.



    A = ANOTHER    E = END

]LIST

10  REM CHANGE INCHES TO
20  REM MILIMETERS.
30  REM
35  HOME : PRINT : PRINT : PRINT

40  REM INPUT # OF INCHES
50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF INCHES TO BE"
60  PRINT "CONVERTED TO MM, IN DE
     CIMAL FORM";: INPUT I
70  REM CONVERT TO MILIMETERS
80 MM = I * 25.4
90  REM OUTPUT ANSWER
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)I;" INCHES = "
     ;MM;" MILIMETERS."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 35
160  END

]
```

The third program is "FEET TO CM". This program converts feet to centimeters. It first reads in the number of feet. Then it convert them to centimeters, and finally it outputs the convertion. An example would be if you wanted to no how many centimeters are in a square(100 square feet). You would first type in 100 for the number of feet, then the program would output the convertion to centimeters.

Here is a sample run and listing of the program.

```
RUN FEET TO CM



    ENTER THE NUMBER OF FEET TO BE
CONVERTED TO CM, IN DECIMAL FORM?100



    100 FEET = 3048 CENTIMETERS.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT FEET TO CM
20  REM
30  REM INPUT THE # OF FEET
35  HOME : PRINT : PRINT : PRINT

40  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF FEET TO BE"
50  PRINT "CONVERTED TO CM, IN DE
     CIMAL FORM";: INPUT F
60  REM CONVERT TO CM
70 CM = F * 30.48
80  REM OUTPUT CONVERTION
85  PRINT : PRINT : PRINT
90  PRINT  TAB( 5)F;" FEET = ";CM
     ;" CENTIMETERS."
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)"A = ANOTHER
      E = END"
120  GET A$
130  IF A$ = "A" GOTO 35
140  END

]
```

The next program is "FEET TO METERS". This program will read in the number of feet to be converted, then it will convert them to meters, and finally it will output the convertion. For example, say you wanted to know how many meters there are from the floor to an eight foot cieling is. You would enter 8, and the program would output the number of meters there are in eight feet.

Here is a sample run and listing of the program.

```
RUN FEET TO METERS



    ENTER THE NUMBER OF FEET TO BE
CONVERTED TO METERS?8



    8 FEET = 2.4384 METERS.



    A = ANOTHER    E = END

]LIST

10  REM CONVERT FEET TO METERS
20  REM
30  REM INPUT THE # OF FEET
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF FEET TO BE"
60  PRINT "CONVERTED TO METERS";:
      INPUT F
70  REM CONVERT TO METERS
80 M = F * .3048
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)F;" FEET = ";M
     ;" METERS."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

The next program is "YARDS TO CM". This program converts yards to centimeters. It will first read in the number of yards, then convert them to centimeters, and finally output the convertion. For example say you wanted to know how many centimeters are in three yards of fabric. You would enter three as the number of yards to be converted and the program would report the convertion to centimeters.

Here is a sample run and listing of the program.

```
RUNYARDS TO CM



    ENTER THE NUMBER OF YARDS TO BE
CONVERTED TO CM, IN DECIMAL FORM?3



    3 YARDS = 274.32 CENTIMETERS.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT YARDS TO CM
20  REM
30  REM INPUT THE # OF YARDS
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF YARDS TO BE"
60  PRINT "CONVERTED TO CM, IN DE
     CIMAL FORM";: INPUT Y
70  REM CONVERT TO CM
80 CM = Y * 91.44
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)Y;" YARDS = ";
     CM;" CENTIMETERS."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

the next program is "YARDS TO METERS". This program will convert yards to meters. First it reads in the number of yards to be converted, then it converts them to meters, and finally it outputs the convertion. An example would be if you wanted to know how many meters are in the 100 yard dash. You would first enter 100 as the number of yards to be converted, then the program would output the convertion in meters.

Here is a sample run and listing of the program.

```
RUN YARDS TO METERS



    ENTER THE NUMBER OF YARDS TO BE
CONVERTED TO METERS, IN DECIMAL FORM?100



    100 YARDS = 91.44 METERS.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT YARDS TO METERS
20  REM
30  REM INPUT THE # OF YARDS
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF YARDS TO BE"
60  PRINT "CONVERTED TO METERS, I
     N DECIMAL FORM";: INPUT Y
70  REM CONVERT TO METERS
80 M = Y * .9144
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)Y;" YARDS = ";
     M;" METERS."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

The next program is "MILES TO METERS". This program will read in the number of miles, convert them to meters, and output the convertion. An example would be determining the number of meters in a mile. To do this you would enter 1 as the number of miles to be converted, then the program would output the number of meters in a mile.

Here is a sample run and listing of the program.

```
RUN MILES TO METERS


    ENTER THE NUMBER OF MILES TO BE
CONVERTED TO METERS, IN DECIMAL FORM?1


    1 MILES = 1609.344 METERS.


    A = ANOTHER    E = END

]LIST

10  REM CONVERT MILES TO METERS
20  REM
30  REM INPUT THE # OF MILES
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF MILES TO BE"
60  PRINT "CONVERTED TO METERS, I
     N DECIMAL FORM";: INPUT MI
70  REM CONVERT TO METERS
80 ME = MI * 1609.344
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)MI;" MILES = "
     ;ME;" METERS."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

The next program is "MILES TO KILOMETERS". This program will convert miles to kilometers. It first reads in the number of miles, then converts them to kilometers, and finally outputs the convertion. For instance say you had to go on a trip of 512 miles, and you wanted to know how many kilometres it would be. To determine this you would enter 512 and the program would output the convertion in kilometers.

Here is a sample run and listing of the program.

```
RUN MILES TO KILOMETERS



    ENTER THE NUMBER OF MILES TO BE
CONVERTED TO KILOMETERS, IN DECIMAL
FORM?512



    512 MILES = 823.984128 KILOMETERS.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT MILES TO
15  REM KILOMETERS
20  REM
30  REM INPUT THE # OF MILES
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF MILES TO BE"
60  PRINT "CONVERTED TO KILOMETER
     S, IN DECIMAL"
65  PRINT "FORM";: INPUT M
70  REM CONVERT TO KILOMETERS
80 K = M * 1.609344
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)M;" MILES = ";
     K;" KILOMETERS."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

The next program is "CENTIMETERS TO INCHES". This program converts centimeters to inches. It will read in the number of centimeters, then convert them to inches, and finally output the convertion. For instance, say you wanted to know how many inches were in the diameter of a circle, if the circle had a diameter of 6 centimeters. You could find this out by running the program and entering 6 as the number of centimeters to be converted. The progam would output the number of inches in 6 centimteres.

Here is a sample run and listing of the program.

```
RUN CENTIMETERS TO INCHES



    ENTER THE NUMBER OF CENTIMETES
TO BE CONVERTED TO INCHES, IN DECIMAL?6



    6 CENTIMETER = 2.3622 INCHES.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT CENTIMETERS TO IN

20  REM INPUT THE # OF
30  REM CENTIMETERS
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF CENTIMETES"
60  PRINT "TO BE CONVERTED TO INC
     HES, IN DECIMAL";: INPUT C
70  REM CONVERT TO INCHES
80 I = C * .3937
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)C;" CENTIMETER
      = ";I;" INCHES."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

The next program is "CENTIMETERS TO FEET". This program will convert centimeters to feet. It will read in the number of centimters to be converted, convert them to feet and output the convertion. An example would be if you wanted to know how many feet are in 500 square centimeters. You could find this out by entering 500 as the number of centimeters to be converted to feet. The program would output the number of feet in 500 centimeters.

Here is a sample run and listing of the program.

```
RUN CENTIMETERS TO FEET



    ENTER THE NUMBER OF CENTIMETES
TO BE CONVERTED TO FEET, IN DECIMAL?500



    500 CENTIMETERS = 16.4041995 FEET.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT CENTIMETERS TO FT

20  REM INPUT THE # OF
30  REM CENTIMETERS
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF CENTIMETES"
60  PRINT "TO BE CONVERTED TO FEE
     T, IN DECIMAL";: INPUT C
70  REM CONVERT TO FEET
80 F = C / 30.48
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)C;" CENTIMETER
     S = ";F;" FEET."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

The next program is "METERS TO FEET". This program will read in the number of meters, convert them to feet, and output the convertion. For instance, say you wanted to know how many feet are in 100 meters. You would enter 100 and the program would output the number of feet.

Here is a sample run and listing of the program.

```
RUN METERS TO FEET



    ENTER THE NUMBER OF METERS TO BE
CONVERTED TO FEET, IN DECIMAL FORM?100



    100 METERS = 328.1 FEET.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT METERS TO FEET
20  REM
30  REM INPUT THE # OF METERS
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF METERS TO BE"
60  PRINT "CONVERTED TO FEET, IN
     DECIMAL FORM";: INPUT M
70  REM CONVERT TO FEET
80 F = M * 3.281
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)M;" METERS = "
     ;F;" FEET."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

The next program is "METERS TO YARDS". This program will read in the number of meters to be converted, convert them to yards, and output the convertion. For instance, say you wanted to know how many yards are in the 300 meter High Herdles. You would enter 300 and the program would output the number of yards.

Here is a sample run and listing opf the program.

```
RUN METERS TO YARDS



    ENTER THE NUMBER OF METERS TO BE
CONVERTED TO YARDS, IN DECIMAL FORM?300



    300 METERS = 328.2 YARDS.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT METERS TO YARDS
20  REM
30  REM INPUT THE # OF METERS
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF METERS TO BE"
60  PRINT "CONVERTED TO YARDS, IN
      DECIMAL FORM";: INPUT M
70  REM CONVERT TO YARDS
80 Y = M * 1.094
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)M;" METERS = "
     ;Y;" YARDS."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

The next program is "KILOMETERS TO YARDS". This program will read in the number of kilometers to be converted, convert them to yards, and output the convertion. An example would be finding the number of yards in a kilometer. You would enter 1, and the program would output the number of yards in a kilometer.

Here is a sample run and listing of the program.

```
RUN KILOMETERS TO YARDS



    ENTER THE NUMBER OF KILOMETERS
TO BE CONVERTED TO YARDS, IN DECIMAL?1



    1 KILOMETERS = 1094 YARDS.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT KILOMETERS TO
15  REM YARDS
20  REM
30  REM INPUT THE # OF
35  REM KILOMETERS.
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF KILOMETERS"
60  PRINT "TO BE CONVERTED TO YAR
     DS, IN DECIMAL";: INPUT K
70  REM CONVERT TO YARDS
80 Y = K * 1094
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)K;" KILOMETERS
      = ";Y;" YARDS."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

The next program is "KILOMETERS TO MILES". This program will read in the number of kilometers, convert them to miles, and output the convertion. For instance, say you see a distance on a European map of 12 kilometers, and you want to know how many miles that is. You could find this out by running this program, entering twelve for the number of kilometers to be converted, and the program would output the number of miles in 12 kilometers.

Here is a sample run and listing of the program

```
RUN KILOMETERS TO MILES



    ENTER THE NUMBER OF KILOMETERS
TO BE CONVERTED TO MILES, IN DECIMAL?12



    12 KILOMETERS = 7.4568 MILES.



    A = ANOTHER    E = END

]LIST

10  REM CONVERT KILOMETERS TO
15  REM MILES
20  REM
30  REM INPUT THE # OF
35  REM KILOMETERS.
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF KILOMETERS"
60  PRINT "TO BE CONVERTED TO MIL
     ES, IN DECIMAL";: INPUT K
70  REM CONVERT TO MILES
80 M = K * .6214
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)K;" KILOMETERS
      = ";M;" MILES."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

The next program is "GALLONS TO LITERS". This program will read in the number of gallons to be converted, convert them to liters, and output the convertion. Say you wanted to determine how many liter coke bottles it would take to fill a gallon milk jug. You could do this by running this program and entering 1 as the number of gallons to be converted. The program would then output the number number of liters it would take to fill a gallon jug.

Here is a sample run and listing of the program.

```
RUN GALLONS TO LITERS



    ENTER THE NUMBER OF GALLONS TO BE
CONVERTED TO LITERS, IN DECIMAL FORM?1



    1 GALLONS = 3.78501136 LITERS.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT GALLONS TO
15  REM LITERS.
20  REM
30  REM INPUT THE # OF GALLONS
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF GALLONS TO BE"
60  PRINT "CONVERTED TO LITERS, I
     N DECIMAL FORM";: INPUT G
70  REM CONVERT TO LITERS
80 L = G / .2642
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)G;" GALLONS =
     ";L;" LITERS."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

the next program is "LITERS TO GALLONS". This program will read in the number of liters, convert them to gallons and output the convertion. For instance, say your car has a 50 liter gas tank and you want to know how many gallons are in 50 liters. You could determine this by running this program and inputing 50 as the number of liters. The program would then output the number of gallons in 50 liters.

Here is a sample run and listing of the program.

```
RUN LITERS TO GALLONS



    ENTER THE NUMBER OF LITERS TO BE
CONVERTED TO GALLONS, IN DECIMAL FORM?50



    50 LITERS = 13.21 GALLONS.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT LITERS TO
15  REM GALLONS.
20  REM
30  REM INPUT THE # OF LITERS
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE NUMB
     ER OF LITERS TO BE"
60  PRINT "CONVERTED TO GALLONS,
     IN DECIMAL FORM";: INPUT L
70  REM CONVERT TO GALLONS
80 G = L * .2642
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)L;" LITERS = "
     ;G;" GALLONS."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

The next program is "FAHRENHIET TO CELSIUS". This program will read in a temperature in fahrenhiet, convert it to celsius, and output the convertion. Say it is 76 degrees outside and you want to know how many degrees celsius it is. You could determine this by running this program and entering 76 as the temperature. The program will then convert 76 to celsius and output the convertion.

Here is a sample run and listing of the program.

```
RUN FAHRENHEIT TO CELSIUS



    ENTER THE TEMPERATURE IN FAHRENHEIT
DEGREES TO BE CONVERT TO CELSIUS?76



76 DEGREES FAHRENHEIT = 24.444 DEGREES
CELSIUS.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT FAHRENHEIT
15  REM TO CELSIUS.
20  REM
30  REM INPUT TEMPERATURE
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE TEMP
     ERATURE IN FAHRENHEIT"
60  PRINT "DEGREES TO BE CONVERT
     TO CELSIUS";: INPUT F
70  REM CONVERT
80 C = 5 * (F - 32) / 9
85 C =  INT (C * 1000 + .5) / 100
     0
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT F;" DEGREES FAHRENHEIT
      = ";C;" DEGREES"
115  PRINT "CELSIUS."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

the next program is "CELSIUS TO FAHRENHIET". This program will read in the temperature in celsius, convert it to fahrenhiet, and output the convertion. An example would be if you have a reading of 24 degrees off a cemical and wanted to know what the temperature of the cemical in fahrenhiet is. You could run this program, enter 24, and the program would output the convertion.

Here is a sample run and listing of the program.

```
RUN CELSIUS TO FAHRENHEIT



    ENTER THE TEMPERATURE IN CELSIUS TO
BE CONVERTED TO FAHRENHEIT?24



    24 DEGREES CELSIUS = 75.2 DEGREES
FAHRENHEIT.



    A = ANOTHER   E = END

]LIST

10  REM CONVERT CELSIUS TO
15  REM FAHRENHEIT.
20  REM
30  REM INPUT TEMPERATURE
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"ENTER THE TEMP
     ERATURE IN CELSIUS TO"
60  PRINT "BE CONVERTED TO FAHREN
     HEIT";: INPUT C
70  REM CONVERT
80 F = (C * 9) / 5 + 32
90  REM OUTPUT CONVERTION
100  PRINT : PRINT : PRINT
110  PRINT  TAB( 5)C;" DEGREES CE
     LSIUS = ";F;" DEGREES"
115  PRINT "FAHRENHEIT."
120  PRINT : PRINT : PRINT
130  PRINT  TAB( 5)"A = ANOTHER
      E = END"
140  GET A$
150  IF A$ = "A" GOTO 40
160  END

]
```

The next program is "CONVERTIONS". This program will do one of six things and return to the beginning of the program or you can tell it to stop running. The six things are convertions. The convertions or from inches to centimeters, centimeters to inches, feet to meters, meters to feet, yards to meters, and meters to yards.

This program is the culmination of the previous convertion programs. It is written by putting the other programs together in one program. It is controlled by a main menue. The way to use this program is to press the number of the convertion you want. When you do this the program will automaticlly go to the section of code that does that particular convertion.

A note to go with this program is that you can easily expaned it by adding other programs from the collection to this one, and increasing the menue. the parts of this program that do the convertions start at line 1000, and each convertion is 100 lines from the starting point of the one before it. this was done to make it easyer to add to this program.

An exanple of the use of this program would be if you wanted to know how many inches are in 10 centimeters, and how many feet are in 10 meters, and how many meters are in 10 yards. To determine these three convertions You could run the program and first press "2", to convert from cm to inches. Then you would enter 10 for the number of centimeters. The program would output the number of inches and then ask you to "PRESS <RETURN> TO CONTINUE.". When you do press <return> the convertion will disappear, so it might not be a bad idea to write the convertions down on a sheet of paper. Next you would want to press 4, to convert meters to feet. Then you would enter 10 for the number of meters and the program would output the convertion to feet. Press <return> and now you are ready to convert yards to meters, so press 5. Next you will enter 10 for the number of yards. The program will output the number of meters and ask you to press <return>; do it. You would then be ready to stop so press 7 for exit to basic and you are through.

Here then is a sample run and a listing of the program.

```
RUN CONVERSIONS


         MAIN MENUE

    1 = INCHES TO CM
    2 = CM TO INCHES
    3 = FEET TO METERS
    4 = METERS TO FEET
    5 = YARDS TO METERS
    6 = METERS TO YARDS
    7 = EXIT TO BASIC



    ENTER THE NUMBER OF CM TO BE
CONVERTED TO INCHES, IN DECIMAL FORM?10



    10 CENTIMETERS = 3.93700788 INCHES.



    PRESS <RETURN> TO CONTINUE?

         MAIN MENUE

    1 = INCHES TO CM
    2 = CM TO INCHES
    3 = FEET TO METERS
    4 = METERS TO FEET
    5 = YARDS TO METERS
    6 = METERS TO YARDS
    7 = EXIT TO BASIC

    ENTER THE NUMBER OF METERS TO BE
CONVERTED TO FEET, IN DECIMAL FORM?10

    10 METERS = 32.81 FEET.

    PRESS <RETURN> TO CONTINUE?

         MAIN MENUE

    1 = INCHES TO CM
    2 = CM TO INCHES
    3 = FEET TO METERS

1680  PRINT : PRINT : PRINT : PRINT
      TAB( 5)"PRESS <RETURN> TO C
     ONTINUE";: INPUT A$
1690  GOTO 40
1700  END

]
```

```
     4 = METERS TO FEET
     5 = YARDS TO METERS
     6 = METERS TO YARDS
     7 = EXIT TO BASIC


     ENTER THE NUMBER OF YARDS TO BE
CONVERTED TO METERS, IN DECIMAL FORM?10



     10 YARDS = 9.144 METERS.



     PRESS <RETURN> TO CONTINUE?



          MAIN MENUE

     1 = INCHES TO CM
     2 = CM TO INCHES
     3 = FEET TO METERS
     4 = METERS TO FEET
     5 = YARDS TO METERS
     6 = METERS TO YARDS
     7 = EXIT TO BASIC

]LIST

10  REM CONVERT INCHES-CM OR
11  REM FEET-METERS OR
12  REM YARDS-METERS
20  REM
30  REM PRINT MENUE
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 10)"MAIN MENUE"
60  PRINT
70  PRINT  TAB( 5)"1 = INCHES TO
     CM"
80  PRINT  TAB( 5)"2 = CM TO INCH
     ES"
90  PRINT  TAB( 5)"3 = FEET TO ME
     TERS"
100  PRINT  TAB( 5)"4 = METERS TO
      FEET"
110  PRINT  TAB( 5)"5 = YARDS TO
     METERS"
120  PRINT  TAB( 5)"6 = METERS TO
      YARDS"
130  PRINT  TAB( 5)"7 = EXIT TO B
     ASIC"
140  GET A
150  IF A < 1 OR A > 7 THEN  PRINT
     : PRINT : PRINT  TAB( 5)"ILL
     EGAL ENTRY, TRY AGAIN.": PRINT
```

```
    : PRINT : PRINT : GOTO 50
160  IF A = 1 GOTO 1100
170  IF A = 2 GOTO 1200
180  IF A = 3 GOTO 1300
190  IF A = 4 GOTO 1400
200  IF A = 5 GOTO 1500
210  IF A = 6 GOTO 1600
220  IF A = 7 GOTO 1700
1100  REM CONVERT INCHES TO CM
1101  REM
1102  REM INPUT THE # OF INCHES
1105  HOME : PRINT : PRINT : PRINT

1110  PRINT  TAB( 5)"ENTER THE NU
     MBER OF INCHES TO BE"
1120  PRINT "CONVERTED TO CM, IN
     DECIMAL FORM";: INPUT I
1130  REM CONVERT TO CENTIMETERS
1140 C = I * 2.54
1150  REM OUTPUT THE CONVERTION
1160  PRINT : PRINT : PRINT
1170  PRINT  TAB( 5)I;" INCHES =
     ";C;" CENTIMETERS."
1180  PRINT : PRINT : PRINT : PRINT
      TAB( 5)"PRESS <RETURN> TO C
     ONTINUE";: INPUT A$
1190  GOTO 40
1200  REM CONVERT CM TO INCHES
1201  REM
1202  REM INPUT THE # OF CM
1205  HOME : PRINT : PRINT : PRINT

1210  PRINT  TAB( 5)"ENTER THE NU
     MBER OF CM TO BE"
1220  PRINT "CONVERTED TO INCHES,
      IN DECIMAL FORM";: INPUT C
1230  REM CONVERT TO INCHES
1240 I = C / 2.54
1250  REM  OUTPUT THE CONVERTION
1260  PRINT : PRINT : PRINT
1270  PRINT  TAB( 5)C;" CENTIMETE
     RS = ";I;" INCHES."
1280  PRINT : PRINT : PRINT : PRINT
      TAB( 5)"PRESS <RETURN> TO C
     ONTINUE";: INPUT A$
1290  GOTO 40
1300  REM **FEET TO METERS**
1301  REM
1302  REM INPUT THE # OF FEET
1305  HOME : PRINT : PRINT : PRINT

1310  PRINT  TAB( 5)"ENTER THE NU
     MBER OF FEET TO BE"
1320  PRINT "CONVERTED TO METERS,
      IN DECIMAL FORM";: INPUT F
1330  REM CONVERT TO METERS
1340 M = F * .3048
1350  REM OUTPUT THE CONVERTION
1360  PRINT : PRINT : PRINT
```

```
1370  PRINT  TAB( 5)F;" FEET = ";
     M;" METERS."
1380  PRINT : PRINT : PRINT : PRINT
      TAB( 5)"PRESS <RETURN> TO C
     ONTINUE";: INPUT A$
1390  GOTO 40
1400  REM **METERS TO FEET**
1401  REM
1402  REM INPUT THE # OF METERS
1405  HOME : PRINT : PRINT : PRINT

1410  PRINT  TAB( 5)"ENTER THE NU
     MBER OF METERS TO BE"
1420  PRINT "CONVERTED TO FEET, I
     N DECIMAL FORM";: INPUT M
1430  REM CONVERT TO FEET
1440 F = M * 3.281
1450  REM OUTPUT THE CONVERTION
1460  PRINT : PRINT : PRINT
1470  PRINT  TAB( 5)M;" METERS =
     ";F;" FEET."
1480  PRINT : PRINT : PRINT : PRINT
      TAB( 5)"PRESS <RETURN> TO C
     ONTINUE";: INPUT A$
1490  GOTO 40
1500  REM **YARDS TO METERS**
1501  REM
1502  REM INPUT THE # OF YARDS
1505  HOME : PRINT : PRINT : PRINT

1510  PRINT  TAB( 5)"ENTER THE NU
     MBER OF YARDS TO BE"
1520  PRINT "CONVERTED TO METERS,
      IN DECIMAL FORM";: INPUT Y
1530  REM CONVERT TO METERS
1540 M = Y * .9144
1550  REM OUTPUT THE CONVERTION
1560  PRINT : PRINT : PRINT
1570  PRINT  TAB( 5)Y;" YARDS = "
     ;M;" METERS."
1580  PRINT : PRINT : PRINT : PRINT
      TAB( 5)"PRESS <RETURN> TO C
     ONTINUE";: INPUT A$
1590  GOTO 40
1600  REM **METERS TO YARDS**
1601  REM
1602  REM INPUT THE # OF METERS
1605  HOME : PRINT : PRINT : PRINT

1610  PRINT  TAB( 5)"ENTER THE NU
     MBER OF METERS TO BE"
1620  PRINT "CONVERTED TO YARDS,
     IN DECIMAL FORM";: INPUT M
1630  REM CONVERT TO YARDS
1640 Y = M * 1.094
1650  REM OUTPUT CONVERTION
1660  PRINT : PRINT : PRINT
1670  PRINT  TAB( 5)M;" METERS =
     ";Y;" YARDS."
```

The next program is "BOARD CONVERT". This program converts board feet to cubic centimeters. This program is here as a kind of footnote to the convertion package. It is meant to demonstrate a method of using convertions in applications programs. An application program is any program that was concieved and written to be applyied, or used, in preforming a given task.

This program will ask you how many inches thick the board is. Then it will ask how many feet wide the board is. Finally it will ask how many feet long the board is. The program will multiply these three input numbers, then convert the product to centimeters and output the convertion. An example would be to determine the cubic centimeters in a 2 by 12. To do this you would run the program, input 2.75 for the thickness, 2 for the width, and 12 for the length. The program would then output the number of cubic centimeters.

Here is a sample run and listing of the program.

```
RUN BOARD CONVERT


          ***BOARD CONVERT***

          DETERMINING BOARD FEET KNOWING  THICKNESS, WIDTH,
          AND LENGTH.


     HOW MANY INCHES THICK IS THE BOARD?2.75


     HOW MANY FEET WIDE IS IT?2


     HOW MANY FEET LONG IS THE BOARD?12


     THE VOLUME OF ONE BOARD IS 167.64
 CUBED CENTIMETERS.

]LIST

10   REM    THIS PROGRAM IS
20   REM DESIGNED TO GET THE I.A.
25   REM STUDENT USE TO USING THE
30   REM COMPUTER TO AID HIM OR
40   REM HER IN DOING HIS OR HER
50   REM PROJECTS.
60   REM
70   REM  THIS PROGRAM WILL
71   REM CONVERT BOARD FEET
80   REM TO BOARD CENTIMETERS.
```

```
205  REM
206  REM
207  HOME : PRINT : PRINT : PRINT

210  PRINT  TAB( 9)"***BOARD CONV
     ERT***": PRINT
220  PRINT  TAB( 9)"DETERMINING B
     OARD FEET KNOWING  THICKNESS
     , WIDTH, AND LENGTH."
230  PRINT : PRINT : PRINT : PRINT

250  PRINT  TAB( 5)"HOW MANY INCH
     ES THICK IS THE BOARD";: INPUT
     T
251  REM
252  REM CONVERT INCHES THICK
253  REM TO FEET.
254  REM
255 T = T / 12
260  PRINT : PRINT : PRINT
270  PRINT  TAB( 5)"HOW MANY FEET

      WIDE IS IT";: INPUT W: PRINT
     : PRINT : PRINT
280  PRINT  TAB( 5)"HOW MANY FEET
      LONG IS THE BOARD";: INPUT
     L: PRINT : PRINT : PRINT
290 B = T * W * L
291  REM
292  REM COVERT CUBED FEET TO
293  REM CUBED CENTIMETERS.
294  REM
295 C = B * 30.48
300  PRINT  TAB( 5)"THE VOLUME OF
      ONE BOARD IS ";C
310  PRINT " CUBED CENTIMETERS."

]
```

The next program is "CHECKBOOK RECONCILIATION". This program will help you reconzile your checkbook with your bank statement.

For example, say your bank statement says you have $300 in your account. Also it does not show a $100 deposit you made last thursday, or two checks one for $20 and one for $40 that you've written since. You would enter to the program 300 for your ending balance, 100 for the deposits not shown, and 20 and 40 for checks not shown. Then the program will report your account balance. Next the program will ask for your checkbook balance and service charges if there are any. finally the program will report your ajusted account balance. if this does not = your account balance you have some type of error, or the bank does.

Here is a sample run and listing of the program.

```
RUN CHECKBOOK RECONCILIATION


    THIS IS A PROGRAM TO RECONZILE
YOUR CHECK BOOK WITH YOUR BANK STATEMENT.
         DEMONSTRATION PROGRAM
        FOR EDUCATIONAL USE ONLY



    PRESS <RETURN> TO CONTINUE?



    WHAT IS YOUR BANK STATEMENT'S ENDING
BALANCE $?300



    HOW MANY DEPOSITS ARE NOT SHOWN
BY THE STATEMENT?1
WHAT WAS THE AMOUNT OF
                       DEPOSIT 1 $?100



    HOW MANY OUTSTANDING CHECKS
ARE THERE?2



HOW MUCH WAS
             CHECK 1 $?20
             CHECK 2 $?40

YOUR ACCOUNT BALANCE IS $340

    WHAT IS YOUR CHECKBOOK BALANCE?343.30
    WHAT WHERE THE SERVICE CHARGES?3.30

YOUR ADJUSTED ACCOUNT BALANCE IS $340

    DO YOU WANT TO RUN THIS PROGRAM
AGAIN, (Y/N)?
]LIST

5  HOME : PRINT : PRINT : PRINT
10  PRINT  TAB( 5)"THIS IS A PROG
     RAM TO RECONZILE"
15  PRINT "YOUR CHECK BOOK WITH Y
     OUR BANK STATEMENT."
20  REM FUNCTION TO DETERMINE IF
21  REM POSITIVE DOLLAR AMOUNT
22  REM WAS ENTERED.
30  DEF  FN B(X) =  INT (X * 100 +
     .5) / 100 *  SGN (X)
40  VTAB 10
41  INVERSE
```

```
42  HTAB 10: PRINT "DEMONSTRATION
      PROGRAM"
43  HTAB 9: PRINT "FOR EDUCATIONA
     L USE ONLY"
44  NORMAL
45  PRINT : PRINT : PRINT
46  PRINT  TAB( 5)"PRESS <RETURN>
      TO CONTINUE";: INPUT A$
47  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"WHAT IS YOUR B
     ANK STATEMENT'S ENDING"
55  PRINT "BALANCE $";
60  INPUT E
70  REM SPECIAL TEST FOR
71  REM VALID INPUT
75  REM (NEGATIVE # ALLOWED)
77 X = E * 100
80  IF X =  INT (X) THEN 120
90  REM VALID AMOUNT DISPLAY
91  REM ERROR, LOOP TO
95  REM REENTER.
100  GOSUB 680
110  GOTO 50
120  PRINT : PRINT : PRINT
125  PRINT  TAB( 5)"HOW MANY DEPO
     SITS ARE NOT SHOWN"
126  PRINT "BY THE STATEMENT";: INPUT
     I1
127  IF I1 = 0 GOTO 260
128  PRINT "WHAT WAS THE AMOUNT O
     F"
129 D = 0
130  FOR I2 = 1 TO I1
140  HTAB 24: PRINT "DEPOSIT ";I2
     ;" $";
160  INPUT A
170  REM ALL DEPOSITS ENTERED.
190  REM  NO, TEST FOR VALID
195  REM ENTRY.
200  IF ( FN B(A) = A) THEN 240
210  REM  INVALID, PRINT
211  REM STANDARD ERROR,
212  REM LOOP TO RE-ENTER.
220  GOSUB 720
230  GOTO 160
240 D = D + A
250  NEXT I2
260  PRINT : PRINT : PRINT
261  PRINT  TAB( 5)"HOW MANY OUTS
     TANDING CHECKS"
262  PRINT "ARE THERE";: INPUT I1

263  PRINT : PRINT : PRINT
264  IF I1 = 0 GOTO 400
265  PRINT "HOW MUCH WAS"
266 C = 0
270  FOR I2 = 1 TO I1
275  HTAB 14: PRINT "CHECK ";I2;"
```

```
     $";
300  INPUT A
330  REM NO,TEST FOR VALID
331  REM ENTRY.
340  IF ( FN B(A) = A) THEN 380
350  REM INVALID. PRINT
351  REM STANDARD ERROR LOOP
352  REM TO RE-ENTER.
360  GOSUB 720
370  GOTO 300
380 C = C + A
390  NEXT I2
400  PRINT
405 Y =  INT ((E + D - C) * 100 +
     .5) / 100
410  PRINT "YOUR ACCOUNT BALANCE
     IS $";Y
420  PRINT
430  PRINT  TAB( 5)"WHAT IS YOUR
     CHECKBOOK BALANCE";
440  INPUT B
450  PRINT  TAB( 5)"WHAT WHERE TH
     E SERVICE CHARGES";
460  INPUT S
470  REM TEST FOR VALID ENTRY.
480  IF  FN B(S) = S THEN 520
490 IN VAL ID. PRINT ERR OR
495  REM LOOP
500  GOSUB 720
510  GOTO 450
520  PRINT
525 X =  INT ((B - S) * 100 + .5)
      / 100
530  PRINT "YOUR ADJUSTED ACCOUNT
      BALANCE IS $";X
540  IF Y = X THEN 620
550  PRINT
560  PRINT "YOUR ACCOUNT IS OUT O
     F BALANCE"
570  PRINT "MAKE SURE YOU HAVE IN
     CLUDED"
575  PRINT "ALL TRANSACTIONS AGAI
     NST THIS ACCOUNT"
580  PRINT "INCLUDING AUTOMATIC D
     EPOSITS AND"
590  PRINT "INTEREST PAYMENTS AS
     WELL AS"
595  PRINT "PRE-AUTORIZED WITHDRA
     WALS."
600  PRINT
610  REM
620  PRINT
630  PRINT  TAB( 5)"DO YOU WANT T
     O RUN THIS PROGRAM"
635  PRINT "AGAIN. (Y/N)?";
640  GET Z$
650  IF Z$ = "Y" GOTO 47
660  IF Z$ = "N" THEN 760
665  PRINT : PRINT : PRINT "ILLEG
```

```
     AL ENTRY, TRY AGAIN.": PRINT
     : PRINT : PRINT
670  GOTO 630
680  PRINT
690  PRINT "ERROR: ENTER A VALID
     DOLLAR AMOUNT ONLY"
700  PRINT
710  RETURN
720  PRINT
730  PRINT "ERROR: ENTER A POSITI
     VE"
740  PRINT "       DOLLAR AMOUNT
     ONLY"
745  PRINT
750  RETURN
760  END

]
```

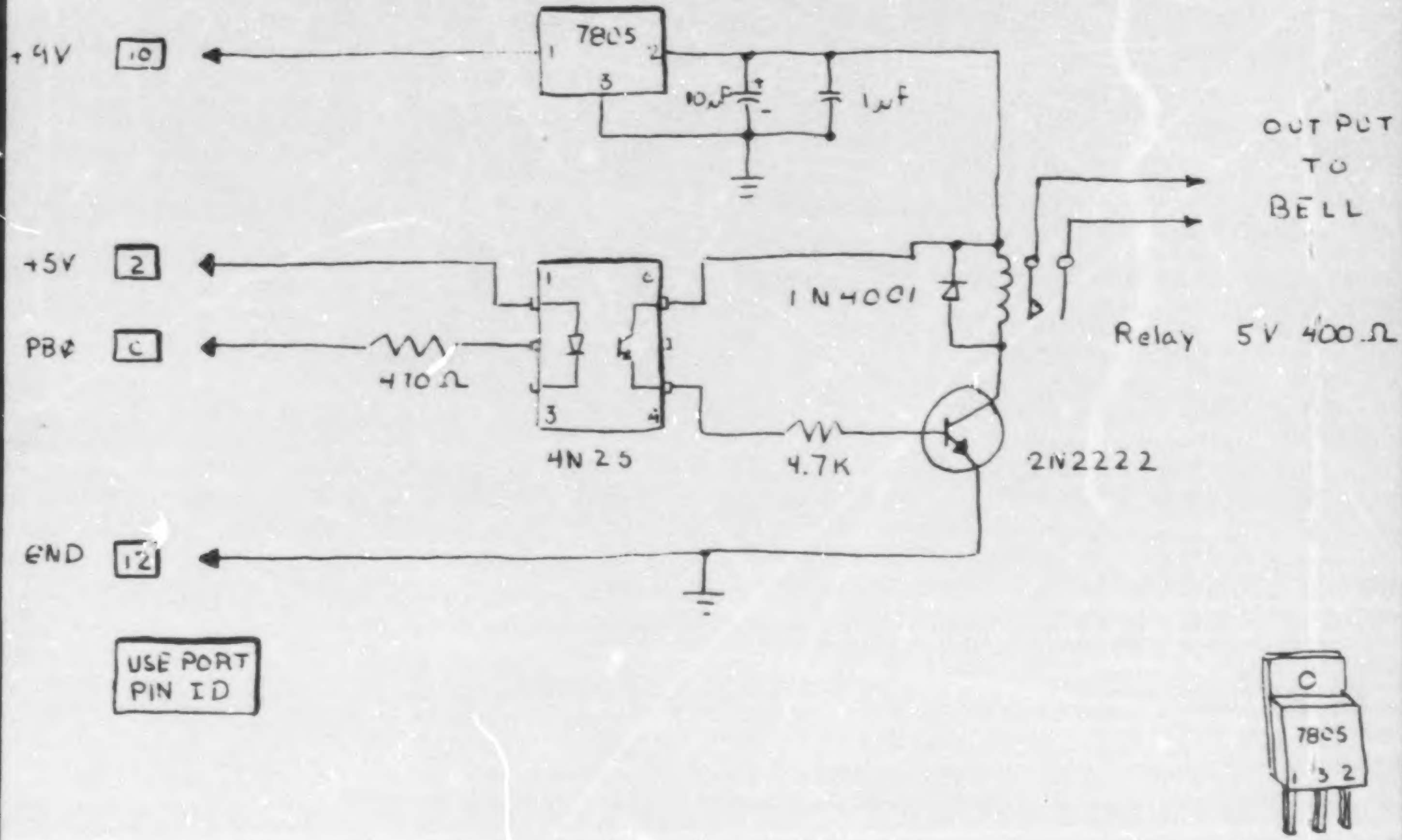
```
0 REM ************************* VIC 20 BELL CONTROLLER ************************
1 REM            ***** REGULAR SCHEDULE DATA*****
2 DATA17,080900,081500,091500,092100,102100,102700,112700,113300,115800,
  120300,1  22800
3 DATA123300,125800,130300,140300,140900,150900
4 REM            ****PEP RALLY SCHEDULE****
5 DATA19,080900,081500,090800,091400,100700,101300,110600,111200,113700,
  114200,1 20700
6 DATA121200,123700,124300,133600,134200,143500,134000,151000
7 REM            ****2:15 SCHEDULE****
8 DATA17,080900,081500,090300,090900,095700,100300,105100,105700,112200,
  112700,1 15200
9 DATA115700,122200,122800,131600,132200,141000
10 REM            ****HOME ROOM SCHEDULE****
11 DATA19,080900,081500,091000,091600,101100,101700,104200,104800,113700,
   114300,120800
12 DATA121300,123800,124300,130800,131400,140900,141500,151000
20 REM****************************************
21 REM ********* MAIN PROGRAM *********
22 REM****************************************
24 DIMB$(30):DD=37136:DR=37138:Z=255:V=254
25 POKEDD,Z:POKEDR,Z
30 A$="       BELL MENU"
40 GOSUB500
45 PRINT:PRINT
60 PRINT" 1=REGULAR SCHEDULE":PRINT
70 PRINT" 2=PEP RALLY SCHEDULE":PRINT
80 PRINT" 3=2:15 SCHEDULE":PRINT
90 PRINT" 4=HOME ROOM SCHEDULE":PRINT
100 PRINT" 5=CLOCK SET":PRINT
110 GOSUB300:GET O$
115 IFTI$="000000"THENGOSUB800
120 IFO$="1"THEN1000
130 IFO$="2"THEN2000
140 IFO$="3"THEN3000
150 IFO$="4"THEN4000
160 IFO$="5"THEN5000
170 GOTO110
300 PRINT"[redacted]TIME ";LEFT$(TI$,2);":";MID$(TI$,3,2);":";
    RIGHT$(TI$,2)
310 PRINT"█DAY  ";D$;"      "
400 POKE63,0:POKE64,0
410 POKE65,0:POKE66,16:RETURN
500 REM HEADING ROUTINE
510 PRINT"J_____________________________"
520 PRINTA$
530 PRINT"______________________________"
540 RETURN

READY.
```

```
600 REM BELL RINING ROUTINE
605 IFD=6THENRETURN
606 IFD=7THENRETURN
610 POKEDD,V
620 T=TI
630 GOSUB300:IFTI<T+240THEN630
640 POKEDD,Z
650 RETURN
700 REM READ BELL SCH DATA STEM
705 PRINT"[redacted]"
710 FORI=1TOA
720 READB$(I)
721 PRINTLEFT$(B$(I),2);":";MID$(B$(I),3,2);":";RIGHT$(B$(I),2),
722 FORL=1TO60:NEXTL
730 NEXTI
740 RETURN
800 REM DAY COUNT
805 Y=TI
806 IFTI<Y+70THEN806
810 D=D+1
830 IFD=8THEN D=1
835 GOTO7000
900 REM BELL OPERATION ROTUINE
905 GOSUB300
910 FORI=1TOA
920 IFTI$=B$(I)THENGOSUB600:REM CHECKS TIME
925 IFTI$="000000"THENGOSUB800
940 NEXTI
950 GETB$:IFB$="M"THEN25
960 GOTO905
1000 REM REG SCD
1010 A$="   REGULAR SCHEDULE"
1020 GOSUB500
1025 GOSUB400
1030 READA
1050 GOSUB700
1060 GOSUB900
2000 REM PEP RALLY SCHEDULE
2010 A$="  PEP RALLY SCHEDULE"
2020 GOSUB500
2025 GOSUB400
2030 FORR=1TO2
2035 GOSUB500
2040 READA:REM READ DATA
2050 GOSUB700
2060 NEXTR
2070 GOSUB900
3000 REM 2:15 SCHEDULE
3010 A$="    2:15 SCHEDULE"
3020 GOSUB500
3025 GOSUB400
3030 FORR=1TO3
3035 GOSUB500
3040 READA:REM READ DATA
3050 GOSUB700
3060 NEXTR
3070 GOSUB900

READY.
```

```
4000 REM HOME ROOM
4010 A$="  HOME ROOM SCHEDULE"
4020 GOSUB500
4025 GOSUB400
4030 FORR=1TO4
4035 GOSUB500
4040 READA:REM READ DATA
4050 GOSUB700
4060 NEXTR
4070 GOSUB900
5000 REM CLOCK SET ROUTINE
5010 A$="   CLOCK SET ROUTINE"
5020 GOSUB500
5025 GOSUB400
5030 GOSUB300
5040 PRINT"[redacted]IS TIME CORRECT? (Y/N)"
5050 GETC$:IFC$="Y"THEN6000
5060 IFC$="N"THEN5074
5070 GOTO5030
5074 GOSUB500
5075 PRINT"[redacted]ENTER TIME (HHMMSS)"
5080 GETF$:IFF$=""THEN5080
5085 PRINT"[redacted]";F$;
5090 GETG$:IFG$=""THEN5090
5095 PRINTG$;
5100 GETH$:IFH$=""THEN5100
5105 PRINTH$;
5110 GETI$:IFI$=""THEN5110
5115 PRINTI$;
5120 GETJ$:IFJ$=""THEN5120
5125 PRINTJ$;
5130 GETK$:IFK$=""THEN5130
5135 PRINTK$
5140 L$=F$+G$+H$+I$+J$+K$
5150 TI$=L$
5200 GOTO5030
6000 REM DAY OF THE WEEK
6005 A$="   DAY OF THE WEEK"
6007 GOSUB500
6010 PRINT"      1= MONDAY":PRINT
6020 PRINT"      2= TUESDAY":PRINT
6030 PRINT"      3= WEDNESDAY":PRINT
6040 PRINT"      4= THURESDAY":PRINT
6050 PRINT"      5= FRIDAY":PRINT
6060 PRINT"      6= SATURDAY":PRINT
6070 PRINT"      7= SUNDAY":PRINT
6080 INPUT"DAY OF THE WEEK";D
6085 GOSUB7000
6100 GOTO25
6110 GETA$:IFA$="Y"THEN25
6120 IFA$="N"THEN6000
6125 GOTO6110
7000 IFD=1THEND$="MONDAY"
7010 IFD=2THEND$="TUESDAY"
7020 IFD=3THEND$="WEDNESDAY"
7030 IFD=4THEND$="THURESDAY"
7040 IFD=5THEND$="FRIDAY"
7050 IFD=6THEND$="SATURDAY"
7060 IFD=7THEND$="SUNDAY"
7070 RETURN
READY.
```


+9V
10
7805
1
2
3
10µF
+
-
1µF
OUTPUT TO BELL
+5V
2
PB0
C
470Ω
1
6
5
3
4
4N25
1N4001
Relay 5V 400Ω
4.7K
2N2222
GND
12
USE PORT PIN ID
C
7805
1 3 2

BELL CONTROLLER

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PROGRAM 2. TEST SCORE EVALUATION

This program will ask for the number of test grades and then ask for each score. It will then find the average, the median, the range and the number of each grade division (A,B,C,D,F) for the class. The letter grade breakdown range is set at 10 point intervals from 60 to 100. This can be changed by altering the values in lines 60 through 75.

To use just load the program and type RUN.

```
10 '  USE THIS PROGRAM TO FIND THE AVERAGE SCORE, THE NUMBER
OF EACH LETTER GRADE, THE RANGE AND THE MEDIAN OF A SET OF TEST SCORES.
15 ' THE SCORES MUST BE IN THE RANGE OF 0 TO 100 WITH LETTER GRADES
A,B,C,D,F IN 10 POINT INCREMENTS FROM 60 TO 100.20 '
25 CLS:PRINT@139,"ENTER EACH SCORE AND PRESS RETURN. ENTER A
NEGATIVE NUMBER AFTER THE LAST SCORE."
30 N=0:A=0:B=0:C=0:D=0:F=0:L=100:H=0:T=0
35 '
40 PRINT"   INPUT SCORE"
45 INPUT S
50 IF S < 0 THEN 150
55 N = N + 1
60 IF S < 60 THEN F = F + 1: GOTO 100
65 IF S < 70 THEN D = D + 1: GOTO 100
70 IF S < 80 THEN C = C + 1: GOTO 100
75 IF S < 90 THEN B = B + 1: GOTO 100
80 A = A + 1
85 '
100 IF S < L THEN L = S
105 IF S > H THEN H = S
110 T = T + S
115 GOTO 40
120 '
150 ' ***  OUTPUT SECTION  ***
152 MED = L + ((H-L)/2):AVE = T/N
155 CLS:PRINT@139,"OF THE ";N;" SCORES, THERE ARE: "
160 PRINT@276,A;" A'S."
165 PRINT@340,B;" B'S."
170 PRINT@404,C;" C'S."
175 PRINT@532,D;" D'S."
180 PRINT@596,F;" F'S."
185 PRINT:PRINT"      THE MEDIAN SCORE IS ";MED
190 PRINT"    THE AVERAGE SCORE IS";AVE
195 PRINT"    THE SCORES RANGED FROM ";L;" TO ";H;"."
200 END
```

```
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-----------------------------------------------------------------
!   .      PROGRAM 4. SUPPLY INVENTORY AND ACCOUNTS            !
!   .                                                          !
!   .        This is a very useful program that can help       !
!   .     manage a school wood or metal shop, art class,       !
!   .     or any situation where students use supplies         !
!   .     that are inventoried and charged to the user.        !
!   .                                                          !
!   .        The student roster must be entered as well as     !
!   .     the inventory items, amount in stock, unit of        !
!   .     charge and price per unit. This information is       !
!   .     saved on disk upon normal exit from the program      !
!   .     and all changes made during an entry session are     !
!   .     also recorded.                                       !
-----------------------------------------------------------------
```

```
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------------------------------------------------------------------
!    .      The program is pretty self-explanatory as           !
!    .    you step through the sections.  These                 !
!    .    sessions include facilities change all data,          !
!    .    add newly received stock, request material            !
!    .    and bill an account for uninventoried material.       !
!    .                                                          !
!    .      When material is requested it is automatically      !
!    .    deducted from inventory, the cost figured and         !
!    .    then charged to the appropriate account.              !
!    .                                                          !
!    .      The program uses disk 0 to store data in a file     !
!    .    called SHOP/DAT.                                      !
!    .                                                          !
------------------------------------------------------------------
```

```
10 '            SCHOOL SHOP INVENTORY AND ACCOUNTS
15 '
20 '  USE THIS PROGRAM TO MAINTAIN AN ACCOUNT OF THE MATERIALS
25 'ON HAND AND HOW MUCH MONEY  EACH STUDENT (ACCOUNT) HAS ON
30 'HIS OR HER BILL.  THERE ARE PROVISIONS FOR CHANGING ALL
35 'DATA, INCLUDING COSTS OF MATERIAL, MATERIAL ON HAND,
40 'ACCOUNTS, AND ACTUAL BILL AMOUNTS.  THE DATA IS STORED ON
45 'DISK UPON EXIT FROM THE PROGRAM.
50 '
55 '
60 CLEAR 3000
65 DIM N(1)                     '  FILE OVERHEAD
70 DIM FI$(49,2)                '  NAMES,DESCRIPTIONS,UNITS
75 DIM MI(49,2)                 '  BILLS,INVENTORY,PRICES
80 '
85 '
90 '      *** FILE READ ROUTINE ***
95 '
100 ON ERROR GOTO 500
105 OPEN"I",1,"SHOP/DAT"
110 INPUT#1,N(0)
111 INPUT#1,N(1)
112 IF N(0) = 0 THEN 5900
115 FOR I = 0 TO N(0) - 1
120   INPUT#1,FI$(I,0)
125   INPUT#1,MI(I,0):NEXT I
129 '
130 FOR I = 0 TO N(1) - 1
135   INPUT#1,FI$(I,1)
137   INPUT#1,FI$(I,2)
139   INPUT#1,MI(I,1)
141   INPUT#1,MI(I,2):NEXT I
145 CLOSE
500 '
510 '      *** MAIN MENU ***
520 '
530 ON ERROR GOTO 8030
540 CLS:PRINT@139,"    SCHOOL SHOP INVENTORY":PRINT
550 PRINT"    ENTER THE NUMBER OF THE DESIRED ACTION."
560 PRINT"          1. REQUEST FOR MATERIALS"
570 PRINT"          2. CHARGE FOR UNINVENTORIED MATERIALS"
580 PRINT"          3. INSPECT INVENTORY TOTALS"
590 PRINT"          4. INSPECT ACCOUNTS"
600 PRINT"          5. CORRECTIONS"
610 PRINT"          6. NEW ACCOUNTS"
620 PRINT"          7. NEW STOCK"
630 PRINT"          8. EXIT"
640 '
650 INPUT C
660 IF C < 1 OR C > 8 THEN 660
670 ON C GOTO 1000,2000,3000,4000,5000,6000,7000,8000
680 '
690 '
1000 '
1010 '      *** REQUEST FOR MATERIAL ***
1020 '
1030 CLS:PRINT@20,"MATERIAL REQUISITION"
1040 PRINT@132,"PRESS"
1050 PRINT"          B TO SEE PREVIOUS MATERIAL."
1060 PRINT"          N TO SEE NEXT MATERIAL."
1070 PRINT"          A IF DISPLAYED MATERIAL IS ONE REQUESTED."
1080 PRINT"          E TO RETURN TO MAIN MENU."
```

```
1100 PRINT@512,"     MATERIAL           AMOUNT IN STOCK           PRICE PER UNIT"
1110 C = 0
1120 '
1130 PRINT@640,"
1140 PRINT@640,FI$(C,1);TAB(25);MI(C,1);FI$(C,2);TAB(50);MI(C,2)
1150 A$ = INKEY$:IF A$ <> "B" AND A$ <> "N" AND A$ <> "A" AND A$ <> "E" THEN 1150
1160   IF A$ = "E" THEN 500         ' RETURN TO MAIN MENU
1170   IF A$ = "A" THEN 1220        ' REQUEST MATERIAL
1180 IF A$ <> "N" THEN 1190
1182   C = C + 1:IF C > N(1)-1 THEN C = 0
1184   GOTO 1130
1190 C = C - 1:IF C < 0 THEN C = N(1)-1
1195 GOTO 1130
1200 'END DISPLAY LOOP
1210 '
1220 FOR I = 128 TO 384 STEP 64
1230   PRINT@I,"
1240 NEXT I
1250 PRINT@139,"HOW MANY ";FI$(C,2);" OF ";FI$(C,1);" DO YOU WANT?"
1260 INPUT M
1270 IF M < MI(C,1) THEN 1310      ' CHECK IF ENOUGH IN STOCK
1280 PRINT"  THERE ISN'T THAT MUCH IN STOCK."
1290 FOR I = 1 TO 500:NEXT I: GOTO 1220
1300 '
1310 GOSUB 1900                    ' GET AND CHECK ACCOUNT NAME
1320 IF FL = 1 THEN 500            ' FL=1 IS WRONG ACCOUNT NAME
1330 '
1340 S = M * MI(C,2)               ' FIGURE COSTS
1350 MI(NA,0) = MI(NA,0) + S       ' CHARGE TO BILL
1360 MI(C,1) = MI(C,1) - M         ' DEDUCT FROM INVENTORY
1370 '
1380 CLS:PRINT@128,FI$(NA,0);" CHARGED ";S;" FOR ";M;FI$(C,2);" OF ";FI$(C,1);"."
1390 PRINT@331,"PRESS C TO CONTINUE"
1400 A$ = INKEY$:IF A$ <> "C" THEN 1400
1410 GOTO 500                      ' RETURN TO MAIN MENU
1420 '
1430 '
1900 '
1910 '    *** ACCOUNT NAME CHECK ROUTINE ***
1920 '
1930 CN = 0: FL = 0
1935 CLS:PRINT@139,"ACCOUNT NAME?"
1940 INPUT A$
1945 NA = 0
1950 IF A$ = FI$(NA,0)  THEN 1995
1955 NA = NA + 1: IF NA > N(0) THEN 1965
1960 GOTO 1950
1965 PRINT@395,"NAME NOT RECOGNIZED."
1970 FOR I = 1 TO 500:NEXTI
1975 CN = CN + 1: IF CN > 3 THEN FL = 1 :GOTO 1995
1980 GOTO 1935
1995 RETURN
2000 '
2010 '     *** CHARGE FOR UNINVENTORIED MATERIAL ***
2020 '
2030 CLS:PRINT@11,"CHARGE FOR UNINVENTORIED MATERIAL"
2040 FOR I = 1 TO 500:NEXT I
2050 GOSUB 1900
2060 IF FL = 1 THEN 500          ' RETURN IF NAME NOT RECOGNIZED
2070 CLS:PRINT@200,"HOW MUCH IS ";FI$(NA,0);" TO BE CHARGED?"
2080 INPUT S
2090 MI(NA,0) = MI(NA,0) + S
2100 PRINT@400,FI$(NA,0);" NOW OWES ";MI(NA,0)
2110 '
2120 PRINT@775,"PRESS C TO CONTINUE."
```

```
2140 GOTO 500                  ' RETURN TO MAIN MENU
2150 '
2160 '
3000 '
3010 '    *** INSPECT INVENTORY ***
3020 '
3030 CLS:PRINT@20,"INVENTORY INSPECTION"
3040 PRINT@132,"PRESS"
3050 PRINT"           B TO SEE PREVIOUS MATERIAL."
3060 PRINT"           N TO SEE NEXT MATERIAL."
3070 PRINT"           E TO RETURN TO MAIN MENU."
3080 '
3090 PRINT@512,"      MATERIAL        AMOUNT IN STOCK        PRICE PER UNIT"
3100 '
3110 C = 0
3120 PRINT@640,"                                                          "
3130 PRINT@640,FI$(C,1);TAB(25);MI(C,1);FI$(C,2);TAB(50);MI(C,2)
3140 A$ = INKEY$:IF A$ <> "B" AND A$ <> "N" AND A$ <> "E" THEN3140
3150 IF A$ = "E" THEN 500         ' RETURN TO MAIN MENU
3160 IF A$ <> "B" THEN 3180
3162   C = C - 1:IF C < 0 THEN C = N(1)-1
3164   GOTO 3120
3180 C = C + 1:IF C > N(1)-1 THEN C = 0
3182 GOTO 3120
3190 '
3200 '
4000 '
4010 '    *** INSPECT ACCOUNTS ***
4020 '
4030 S = 0
4040 FOR I = 0 TO N(0)
4050   S = S + MI(I,0)             ' SUM TOTAL BILLS
4060 NEXT I
4070 '
4080 CLS:PRINT@21,"ACCOUNTS RECEIVABLE"
4090 PRINT@70,"TOTAL OF ALL ACCOUNTS IS $";S
4100 '
4110 PRINT@132,"PRESS"
4120 PRINT"            B TO SEE PREVIOUS ACCOUNT."
4130 PRINT"            N TO SEE NEXT ACCOUNT."
4140 PRINT"            E TO RETURN TO MAIN MENU."
4150 '
4160 PRINT@512,"       ACCOUNT          AMOUNT OWED "
4170 C = 0
4180 PRINT@640,"                                          "
4190   PRINT@640,TAB(5);FI$(C,0);TAB(30);"$";MI(C,0)
4200   A$ = INKEY$: IF A$ <> "B" AND A$ <> "N" AND A$ <> "E" THEN 4200
4210 '
4220   IF A$ = "E" THEN 500           ' RETURN TO MAIN MENU
4230 IF A$ <> "B" THEN 4245
4235    C = C - 1: IF C < 0 THEN C = N(0)-1
4240    GOTO 4180
4245 C = C + 1:IF C > N(0)-1 THEN C = 0
4250 GOTO 4180
4260 '
4270 '
5000 '
5010 '     *** CORRECTIONS ***
5020 '
5030 CLS:PRINT@21,"CORRECTIONS"
5040 PRINT@132,"ENTER"
5050 PRINT"            1. TO CHANGE AN ACCOUNT NAME OR AMOUNT."
5060 PRINT"            2. TO CHANGE A MATERIAL DESCRIPTION,"
5070 PRINT"               UNIT OF MEASURE,INVENTORY AMOUNT OR"
5080 PRINT"               COST PER UNIT."
```

```
5100 INPUT C
5110 IF C < 1 OR C > 2 THEN 5000
5120 ON C GOTO 5200,5600
5130 '
5200 GOSUB 5800            ' CLEAR WINDOW
5210 PRINT@132,"PRESS"
5220 PRINT"                B TO SEE PREVIOUS ACCOUNT."
5230 PRINT"                N TO SEE NEXT ACCOUNT."
5240 PRINT"                A TO ALTER ACCOUNT SHOWN."
5250 PRINT"                E TO RETURN TO MAIN MENU."
5260 '
5270 PRINT@512,"          ACCOUNT                         AMOUNT OWED"
5280 C = 0
5290 PRINT@640,"
5300   PRINT@640,TAB(10);FI$(C,0);TAB(30);"$";MI(C,0)
5310   A$ = INKEY$:IF A$ <> "B" AND A$ <> "N" AND A$ <> "A" AND A$ <> "E" THEN 5310
5320 '
5330   IF A$ = "E" THEN GOTO 500       ' RETURN TO MAIN MENU
5340 IF A$ <> "B" THEN 5350
5342   C = C -1:IF C < 0 THEN C = N(0)-1
5344   GOTO 5290
5350 IF A$ <> "N" THEN 5380
5351   C = C + 1:IF C > N(0)-1 THEN C = 0
5352 GOTO 5290
5360 '
5370 '   ALTER DATA
5380 GOSUB 5800
5390 PRINT@139,"CHANGE ACCOUNT NAME? (Y OR N)"
5400 A$ = INKEY$: IF A$ <> "Y" AND A$ <> "N" THEN 5400
5410 IF A$ = "N" THEN 5470
5420 PRINT@265,"NAME SHOULD BE?"
5430 INPUT FI$(C,0)
5440 '
5470 GOSUB 5800
5480 PRINT@139,"CHANGE AMOUNT OWED? (Y OR N)"
5490 A$ = INKEY$:IF A$ <> "Y" AND A$ <> "N" THEN 5490
5500 IF A$ = "N" THEN 5550
5510 PRINT@265,"AMOUNT SHOULD BE?"
5520 INPUT MI(C,0)
5550 GOTO 500              RETURN TO MAIN MENU
5560 '
5600 '
5605 GOSUB 5800            ' CLEAR WINDOW
5610 PRINT@132,"PRESS"
5615 PRINT"              B TO SEE PREVIOUS DATA."
5620 PRINT"              N TO SEE NEXT DATA."
5625 PRINT"              A TO ALTER DATA SHOWN."
5630 PRINT"              E TO RETURN TO MAIN MENU."
5635 '
5640 PRINT@512,"    MATERIAL          UNIT OF MEASURE           PRICE PER UNIT"
5645 C = 0
5650 '
5655 PRINT@640,"
5660   PRINT@640,FI$(C,1);TAB(25);FI$(C,2);TAB(50);MI(C,2)
5665   A$ = INKEY$:IF A$ <> "B" AND A$ <> "N" AND A$ <> "A" AND A$ <> "E" THEN 5665
5670 '
5675   IF A$ = "E" THEN GOTO 500        ' RETURN TO MAIN MENU
5680 IF A$ <> "B" THEN 5685
5682   C = C - 1:IF C < 0 THEN C = N(1)-1
5683   GOTO 5655
5685 IF A$ <> "N" THEN 5695
5686   C = C + 1:IF C > N(1)-1 THEN C = 0
5687 GOTO 5655
5690 '
5695 GOSUB 5800                'CLEAR WINDOW
```

```
5705 A$ = INKEY$:IF A$ <> "Y" AND A$ <> "N" THEN 5705
5710 IF A$ = "N" THEN 5725
5715 PRINT@265,"DESCRIPTION SHOULD BE?"
5720 INPUT FI$(C,1)
5725 GOSUB 5800                    ' CLEAR WINDOW
5730 PRINT@139,"CHANGE UNIT OF MEASURE? (Y OR N)"
5735 A$ = INKEY$:IF A$ <> "N" AND A$ <> "Y" THEN 5735
5740 IF A$ = "N" THEN 5760
5745 PRINT@265,"UNITS SHOULD BE?"
5750 INPUT FI$(C,2)
5755 '
5760 GOSUB 5800                   'CLEAR WINDOW
5765 PRINT@139,"CHANGE PRICE PER UNIT? (Y OR N)"
5770 A$ = INKEY$ :IF A$ <> "N" AND A$ <> "Y" THEN 5770
5775 IF A$ = "N" THEN GOTO 500       ' RETURN TO MAIN MENU
5780 PRINT@265,"PRICE PER UNIT SHOULD BE?"
5785 INPUT MI(C,2)
5790 GOTO 500              ' RETURN TO MAIN MENU
5795 '
5800 '
5810 '     *** CLEAR WINDOW ROUTINE ***
5820 '
5830 FOR I = 128 TO 448 STEP 64
5840   PRINT@I,"
5850 NEXT I
5860 RETURN
5870 '
5900 '
5910 '     *** FIRST USE START ***
5920 '
5930 ON ERROR GOTO  8150
5940 N(0) = 0 :N(1) = 0
5950 CLS:PRINT@139," SHOP INVENTORY":PRINT
5960 PRINT"   ENTER NEW ACCOUNT NAMES FIRST."
5970 FOR I = 1 TO 700 : NEXT I
5990 '
6000 'CLS:PRINT@139,"NEW ACCOUNT NAME ENTRY"
6010 PRINT:PRINT"  HOW MANY NEW NAMES ARE TO BE ENTERED?"
6020 INPUT UN
6030 IF UN + N(0) > 50 THEN PRINT"TOO MANY":FOR I = 1 TO 500:NEXT I:GOTO 6000
6040 CLS:FOR I = N(0) TO N(0) + UN - 1
6050   PRINT@256,"INPUT NAME AND PRESS ENTER."
6060   INPUT FI$(I,0)
6070 NEXT I
6080 N(0) = N(0) + UN - 1
6090 CLS:PRINT"THERE ARE NOW";N(0)+1;"ACCOUNTS ON FILE."
6100 FOR I = 1 TO 500: NEXT I
6110 GOTO 500
7000 '       *** STOCK RECEIVED OR NEW STOCK ITEM ***
7010 '
7020 CLS:PRINT@139,"ENTER"
7030 PRINT"        1. FOR ADDING TO EXISTING STOCK."
7040 PRINT"        2. FOR ADDING NEW STOCK ITEM."
7050 INPUT C
7060 '
7070 IF C < 1 OF C > 2 THEN 7000
7080 IF C = 2 THEN 7500
7090 '
7100 '   ADDING TO EXISTING STOCK
7110 '
7120 PRINT@139,"ADDING TO EXISTING STOCK"
7130 PRINT@260,"PRESS C TO CONTINUE TO STEP THROUGH THE EXISTINGSTOCK UNTIL THE MATERIAL
     RECEIVED APPEARS
7140 PRINT"  PRESS A TO ADD TO THE DISPLAYED MATERIAL."
7150 '
7160 I = 0
```

```
7180   A$ = INKEY$:IF A$ <> "A" AND A$ <> "C" THEN 7180
7190   IF A$ = "A" THEN GOTO 7250
7200   I = I + 1:IF I > N(1) THEN I = 0
7210   PRINT@460,"                    "
7220 GOTO 7170
7230 '
7240 '
7250 CLS:PRINT@139,"ADDING STOCK TO";FI$(I,1)
7260 PRINT@260,"HOW MANY";FI$(I,2);"HAVE BEEN RECEIVED?"
7270 INPUT UN
7280 MI(I,1) = MI(I,1) + UN
7290 GOTO 500                 ' RETURN TO MAIN MENU
7300 '
7310 '
7500 '
7510 '     *** INPUT NEW TYPES OF MATERIAL ***
7520 '
7530 CLS:PRINT@139,"HOW MANY NEW TYPES OF MATERIAL ARE TO BE ENTERED?"
7540 INPUT UN
7550 IF UN + N(1) > 49 THEN PRINT"TOO MANY":FOR I = 1 TO 500:NEXT I:GOTO 7500
7560 CLS
7570 FOR I = N(1) TO N(1) + UN - 1
7580   CLS:PRINT@139,"INPUT MATERIAL DESCRIPTION (20 CHARACTERS OR LESS)."
7590   INPUT FI$(I,1)
7600 '
7610   PRINT@266,"INPUT UNIT OF MEASURE FOR ";FI$(I,1)
7620   INPUT FI$(I,2)
7630 '
7640   PRINT@390,"HOW MANY ";FI$(I,2);" HAVE BEEN RECEIVED?"
7650   INPUT MI(I,1)
7660 '
7670   PRINT@512,"INPUT THE PRICE PER ";FI$(I,2)
7680   INPUT MI(I,2)
7690 '
7700   PRINT@192,"                              "
7710   PRINT@290,"                              "
7720   PRINT@350,"                              "
7730   PRINT@560,"                              "
7740   PRINT@606,"                              "
7750 NEXT I                      ' RETURN TO MAIN MENU
7760 '
7770 N(1) = N(1) + UN - 1
7780 CLS:PRINT@139,"THERE ARE NOW";N(1);"DIFFERENT MATERIALS."
7790 FOR I = 1 TO 700:NEXT I
7800 GOTO 500
8000 '
8010 '      *** EXIT AND DISK SAVE ROUTINE ***
8020 '
8030 OPEN"O",1,"SHOP/DAT"
8040 PRINT#1,N(0)
8045 PRINT#1,N(1)
8050 '
8060 FOR I = 0 TO N(0) -1
8070   PRINT#1,FI$(I,0)
8075   PRINT#1,MI(I,0):NEXT I
8080 '
8090 FOR I = 0 TO N(1) - 1
8100   PRINT#1,FI$(I,1)
8105   PRINT#1,FI$(I,2)
8110   PRINT#1,MI(I,1)
8115   PRINT#1,MI(I,2):NEXT I
8130 '
8140 CLOSE
8150 END
```

```
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------------------------------------------------------------------
!    .       PROGRAM 5. RECYCLING ACCOUNT FILE                   !
!    .                                                           !
!    .         This program will help maintain accounts          !
!    .       of how much money each student has earned in        !
!    .       collecting recylable materials.  The program        !
!    .       is originaly set up to work for aluminum cans       !
!    .       at 30 cans a pound and 31 cents per pound.          !
!    .       This can be changed by altering lines 520           !
!    .       through 550 to the appropriate values.              !
!    .                                                           !
!    .         After entering the class role on the first        !
!    .       use, the data is saved on disk 0 and is reloaded    !
!    .       whenever the program is run.                        !
------------------------------------------------------------------
```

```
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-----------------------------------------------------------------
!    .     To record what a student brings in as recyclable     !
!    .   material, select 2 on the main menu.  Step through     !
!    .   the class role until the students name appears         !
!    .   and then press A.  The program will then ask for       !
!    .   the number of cans recovered. After receivig this,     !
!    .   the program will figure the dollar value of the        !
!    .   material and credit the student account.               !
!    .                                                          !
!    .     All current dollar values are also saved on disk.    !
!    .                                                          !
!    .                                                          !
!    .                                                          !
!    .                                                          !
-----------------------------------------------------------------
```

```
10 '
20 '
30 '  USE THIS PROGRAM TO KEEP TRACK OF HOW MUCH MONEY EACH
40 'STUDENT HAS EARNED BY COLLECTING SALVAGEABLE MATERIAL.
50 'THE PROGRAM IS SET UP FOR ALUMINUM CANS AT 30 CANS PER
60 'POUND AND 31 CENTS PER POUND. THIS CAN BE EASILY CHANGED
70 'IN THE DEFINITION SECTION.
80 '
90 '
100 CLEAR 1000
110 ON ERROR GOTO 1000
120 DIM NM$(49)                      ' ALLOW FOR 50 NAMES
130 DIM AM(49)                       ' ALLOW FOR 50 AMOUNTS
140 '
150 OPEN "I",1,"RECYC"
160 INPUT#1,NS                       ' GET NUMBER OF STUDENTS
170   IF NS = 0 THEN 1000
180 '
190 FOR I = 0 TO NS-1
200   INPUT#1,NM$(I)                 ' READ NAMES
210   INPUT#1,AM(I)                  ' READ AMOUNTS
220 NEXT I
225 CLOSE
230 '
500 '        *** DEFINTION SECTION ***
510 '
520 UP = 30                          ' 30 CANS TO A POUND
530 PP = .31                         ' 31 CENTS PER POUND
540 SM$ = "ALUMINUM CANS"            ' SALVAGE MATERIAL
550 U$ = "CANS"                      ' UNITS OF SALVAGE
560 '
570 '
700 '        *** MAIN MENU ***
710 '
720 CLS:PRINT@20,"CLASS RECYCLING RECORDS"
730 PRINT@139,"ENTER..."
740 PRINT"               1. TO ADD NAMES TO THE LIST."
750 PRINT"               2. TO RECORD COLLECTIONS."
760 PRINT"               3. TO EXAMINE TOTALS."
770 PRINT"               4. TO CHANGE DATA."
780 PRINT"               5. TO EXIT."
790 '
800 INPUT C
810 IF C < 1 OR C > 5 THEN 700
820 ON C GOTO 1000,2000,3000,4000,5000
830 '
840 '
1000 '        *** ADD NAMES ***
1010 '
1020 CLS:PRINT@135,"HOW MANY NEW NAMES ARE TO BE ADDED?"
1030 INPUT C
1040 IF C < 49-NS THEN 1090
1050   PRINT"TOO MANY"
1060   FOR I = 1 TO 500:NEXT I
1070   GOTO 1000
1080 '
1090 FOR I = NS TO NS + C - 1
1100   PRINT"ENTER THE NAME AND PRESS ENTER."
1110   INPUT NM$(I):AM(I) = 0
1120 NEXT I
1125 NS = NS + C
1130 '
```

```
1150 '
2000 '      *** RECORD COLLECTIONS ***
2010 '
2020 CLS:GOSUB 2500
2030 IF A$ = "E" THEN 700
2040 PRINT@650,"HOW MANY ";U$;" DID ";NM$(M);" COLLECT?"
2050 INPUT NUM
2060 S = (NUM/UP)*PP
2070 AM(M) = AM(M) + S
2080 PRINT:PRINT ;"     COLLECTED MATERIAL AMOUNTS TO ";S
2090 FOR I = 1 TO 500:NEXT I
2100 GOTO 700
2110 '
2500 '        *** ACCOUNT LIST SUBROUTINE ***
2510 '
2520 CLS:PRINT@21,"ACCOUNTS"
2530 PRINT@130,"PRESS        B  TO SEE PREVIOS ACCOUNT."
2540 PRINT   "              N  TO SEE NEXT ACCOUNT."
2550 PRINT   "              A  IF ACCOUNT SHOWN IS TO BE ALTERED."
2560 PRINT   "              E  TO RETURN TO MAIN MENU.
2570 '
2580 M = 0
2590 PRINT@448,"      STUDENT                    DOLLARS COLLECTED"
2600 '
2610 PRINT@520,"                                             "
2620 PRINT@520,"      ";NM$(M);"              ";:PRINT USING "$###.##";AM(M)
2630 A$ = INKEY$:IF A$ <> "B" AND A$ <> "N" AND A$ <> "A" AND A$<> "E" THEN 2630
2640 '
2650 IF A$ = "A" OR A$ = "E" THEN 2730
2660 IF A$ = "N" THEN 2700
2670   M = M - 1 :IF M < 0 THEN M = NS - 1
2680   GOTO 2610
2690 '
2700 M = M + 1: IF M > NS - 1 THEN M = 0
2710 GOTO 2610
2720 '
2730 RETURN
3000 '        *** LIST RECORDS ***
3010 '
3015 TL = 0
3020 FOR I = 0 TO NS-1
3030   TL = TL + AM(I)
3040 NEXT I
3050 CLS:PRINT " TOTAL AMOUNT = ";TL
3060 FOR I = 1 TO 500:NEXT I
3070 GOSUB 2500
3080 GOTO 700
3090 '
4000 '       *** CORRECTIONS ***
4010 '
4020 GOSUB 2500
4030 IF A$ = "E" THEN 700
4040 '
4050 PRINT:PRINT"  CHANGE NAME ? (Y OR N)"
4060 A$ = INKEY$: IF A$ <> "Y" AND A$ <> "N" THEN 4060
4070 IF A$ = "N" THEN 4100
4080   PRINT"  NAME SHOULD BE ?"
4090   INPUT NM$(M)
4100 PRINT:PRINT"CHANGE DOLLAR VALUE ? (Y OR N)"
4110 A$ = INKEY$ :IF A$ <> "Y" AND A$ <> "N" THEN 4110
4120 IF A$ = "N" THEN 700
4130   PRINT" AMOUNT SHOULD BE ?"
4140   INPUT AM(M)
4150 GOTO 700
4160 '
```

```
5010 '
5015 CLOSE
5020 OPEN "O",1,"RECYC"
5030 PRINT#1,NS
5040 FOR I = 0 TO NS - 1
5050   PRINT#1,NM$(I)
5060   PRINT#1,AM(I)
5070 NEXT I
5080 CLOSE
5090 '
5100 CLS:PRINT@139,"DO YOU WANT A PRINTED RECORD ? (Y OR N)"
5110 A$ = INKEY$: IF A$ <> "N" AND A$ <>"Y" THEN 5110
5120 IF A$ = "N" THEN 5190
5130    PRINT"MAKE SURE PRINTER IS ON."
5140    FOR I = 1 TO 1000:NEXT I:S = 0
5143   LPRINT"            SALVAGE RECORDS":LPRINT""
5145 LPRINT"------------------------------------"
5150    FOR I = 0 TO NS -1
5160     LPRINT NM$(I);TAB(30);:LPRINT USING"$###.##";AM(I)
5165    S = S + AM(I)
5170    NEXT I
5175 LPRINT"":  LPRINT" TOTAL DOLLARS = ";S
5180 '
5190 END
```

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PROGRAM 6. CLASS CHORE ASSIGNMENTS

Use this program to randomly assign classroom chores to students in order to avoid making the same assignment regularly.

The class role must be entered the first time and can be altered with any use. If there are more students than chores, more than one student will be assigned. If there are more chores than students, more chores will be assigned to students.

The class role and chore list will be saved

on normal exit from the program. Both will be automatically reloaded when the program is run again.

```
5 '    USE THIS PROGRAM TO ASSIGN CHORES TO THE STUDENTS OF A
10 ' CLASS. THE PROGRAM WILL ASK FOR THE NAMES OF THE STUDENTS
15 ' AND CHORES ONCE AND THEN SAVE THEM ON DISK. YOU CAN
20 ' CHANGE THEM ANYTIME YOU RUN THE PROGRAM AND THE CORRECT
25 ' VERSION IS SAVED WHEN YOU EXIT THE PROGRAM.
30 '   THE PROGRAM WILL RANDOMLY ASSIGN CHORES TO STUDENTS
35 ' SO THERE IS LITTLE POSSIBILITY OF THE SAME STUDENT BEING
40 ' ASSIGNED THE SAME CHORE ON CONSECUTIVE DAYS.
45 '
100 CLEAR 5000
105 ON ERROR GOTO 500
110 DIM CL$(40),AS(40),CH$(40)
115 OPEN "I",1,"CHORES/EMP"
120 J = 0:W = 0
130 IF EOF(1) THEN 155
132 INPUT#1,CL$(J)
135 IF CL$(J) = "END" THEN 150
140 J = J + 1:GOTO 130
145 GOTO  500
150 IF (EOF(1) OR  CH$(W)="END" ) THEN 155
151 INPUT#1,CH$(W)
152 W = W + 1:GOTO 150
153 W = W-1:J = J-1
155 CLS:PRINT@145,"THE CLASS CHORE ASSIGNMENT PROGRAM"
160 PRINT@267,"CLASSROOM CHORES ARE ASSIGNED IN A RANDOM ORDER."
165 PRINT"THE NAMES AND CHORES ARE STORED ON DISK AFTER THEY ARE
    ENTERED  WITH THE FIRST USE."
167 GOSUB 4000                   ' **** WAIT LOOP
170 '
175 GOSUB 1000               ' ASK FOR ANY CHANGES
180 '
185 IF A$<>"N" THEN 160
190 GOSUB 2500               ' MAKE RANDOM ASSIGNMENTS
195 GOSUB 3000               ' ASK IF PRINTOUT IS WANTED
200 GOSUB 3500               ' EXIT?
205 IF A = 1 THEN 190
210 GOTO 5000                ' CALL EXIT
215 '
220 '
500 CLS:PRINT"                        THE STUDENT ROLE":PRINT@139,
    "HOW MANY STUDENTS ARE IN THE CLASS?"
505 PRINT@267,"PLEASE PRESS ENTER AFTER YOUR ANSWER."
510 FOR I = 0 TO 40:CL$(I)="                    ":CH$="     ":NEXT I
512 INPUT J
515 IF J<2 OR J>40 THEN 500
520 CLS:PRINT@133,"TYPE IN THE STUDENTS NAMES AND PRESS ENTER
    AFTER EACH ONE."
525 FOR I = 1 TO J
530   INPUT CL$(I-1)
535 NEXT I
555 '
560 GOSUB 1580                    'PRINT CLASS ON SCREEN
565 GOSUB 4000                    ' **** WAIT LOOP
570 '
575 CLS:PRINT@139,"HOW MANY CHORES ARE THERE TO BE ASSIGNED?"
580 INPUT W
585 IF W < 1 OR W > 40 THEN 575
590 CLS:PRINT@321,"TYPE IN A DESCRIPTION (20 CHARACTERS OR LESS)
    OF EACH CHORE."
```

```
600 FOR I = 0 TO W - 1
605   INPUT CH$(I)
610 NEXT I
615 K = INT(.5+W/2):GOSUB 900
620 GOSUB 4000                         ' **** WAIT LOOP
625 GOTO 155
630 '
900 ' THIS ROUTINE LIST THE CLASS CHORES.
905 CLS:L=0:F=0:N=W-1:CA=0
910 P=N:IF P > 10 THEN P = 10
915 PRINT@75,"    THE CHORE LIST":FOR I = L TO P STEP 2
920      PRINT TAB(5);I+1;CH$(I);TAB(30);I+2;CH$(I+1)
925 NEXT I
930 IF F = 1 THEN 995
935 GOSUB 4200:N = N - 10
940 IF AS$="C" THEN 995
945 IF N < 10 THEN 990
950 L=P:P=P+10
955 FOR I = 128 TO 704 STEP 64:PRINT@I,"
960 GOTO915
990 L=P+1:P=J-1:F=1:GOTO 915
995 RETURN
1000 CLS:PRINT@139,"IF YOU WISH TO MAKE CHANGES IN THE CLASS
     ROLE TYPE C.             IF A CHORE CHANGE IS NEEDED TYPE W."
1005 PRINT@267,"TYPE N IF NO CHANGES ARE NEEDED."
1010 A$ = INKEY$: IF A$ = "" THEN 1010
1015 IF A$ = "N" THEN 1040
1020 IF A$ = "C" THEN GOSUB 1500
1025 IF A$ = "W" THEN GOSUB 2000
1030 GOTO 1000
1035 '
1040 RETURN
1500 ' THIS ROUTINE ALLOWS THE USER TO ALTER THE CLASS ROLE.
1505 GOSUB 1580
1510 PRINT"TYPE :":FOR I = 576 TO 639:PRINT@I," ":NEXTI
1515 PRINT"            1  TO CHANGE A NAME."
1520 PRINT"            2  TO ADD NAMES."
1525 PRINT"            3  TO DELETE NAMES."
1530 INPUT C
1535 IF C < 1 OR C > 3 THEN 1510
1540 '
1545 ON C GOTO 1700,1770,1890
1550 '
1580 PRINT:CLS:L=0:F=0:N=J-1:CA=0
1582 P=N:IF P>10 THEN P=10
1584 CLS:PRINT@75,"    THE CLASS ROLE":PRINT:  FOR I = L TO
     P STEP 2
1586      PRINTTAB(5);I+1:CL$(I);TAB(30);I+2:CL$(I+1)
1588   NEXT I
1590 IF F = 1 THEN 1610
1592 GOSUB 4200:N = N - 10
1593 IF AS$ = "C" THEN 1610
1594 IF N < 10 THEN 1600
1596 L = P :P = P + 10
1597 FOR I = 128 TO 704 STEP 64:PRINT@I,"
1598 GOTO 1584
1600 L = P+1:P = J-1:F = 1:GOTO 1584
1610 RETURN
```

```
1615 '
1620 PRINT@907,"DO YOU WANT TO MAKE ANY MORE CHANGES?"
1625 PRINT"TYPE Y (YES) OR N (NO)."
1630 A$ = INKEY$:IF A$ = "" THEN 1630
1640 RETURN
1645 '
1700 '
1705 PRINT "ENTER THE NUMBER OF THE NAME TO BE CHANGED."
1710 INPUT C
1715 IF C < 1 OR C > 40 THEN 1705
1720 PRINT "TYPE IN THE NEW NAME AND PRESS ENTER."
1725 INPUT CL$(C-1)
1730 GOSUB 4000           ' PRINT CLASS AND WAIT
1745 RETURN
1770 K = 40 - J
1775 CLS:PRINT"THERE ARE ";K;"AVAILABLE AREAS FOR NEW NAMES"
1780 PRINT"HOW MANY NEW NAMES ARE TO BE ADDED?"
1785 INPUT L
1790 IF L > K THEN 1770
1795 PRINT "TYPE IN EACH NAME AND PRESS ENTER."
1800 FOR I = J TO J+L-1
1805   INPUT CL$(I)
1810 NEXT I
1815 J = J + L
1820 '
1825 GOSUB 1620
1835 IF A$ = "Y" THEN 1505
1840 RETURN
1890 '
1895 '
1900 '
1915   PRINT"ENTER THE NUMBER OF THE NAME TO BE DELETED."
1920   INPUT L
1925   FOR N = L TO J-1
1930     CL$(N-1) = CL$(N)
1940     J = J - 1
1945   NEXT N
1947 CL$(J) = "                    "
1955 '
1965 GOSUB 1620
1970 IF A$ = "Y" THEN 1505
1975 RETURN
2000 GOSUB 700                     ' PRINT CHORES
2005 PRINT" TYPE IN :"
2010 PRINT"           1  TO CHANGE A CHORE."
2015 PRINT"           2  TO ADD CHORES."
2020 PRINT"           3  TO DELETE CHORES."
2025 '
2030 INPUT C
2035 IF C < 1 OR C > 3 THEN 2000
2040 ON C GOTO 2100,2200,2300
2100 '
2105 PRINT"ENTER THE NUMBER OF THE CHORE TO BE CHANGED."
2110 INPUT C
2115 IF C < 0 OR C > 40 THEN 2000
2120 PRINT " TYPE IN THE NEW CHORE AND PRESS ENTER."
2125 INPUT CH$(C-1)
```

```
2130 '
2135 GOSUB 1620                   ' ASK FOR MORE CHANGES
2140 IF A$ = "Y" THEN 2000
2145 RETURN
2150 '
2200 CLS:K = 40 - W
2205 PRINT " THERE ARE ";K;" AVAILABLE AREAS FOR NEW CHORES."
2210 PRINT " HOW MANY NEW CHORES ARE TO BE ADDED?"
2215 INPUT L
2220 IF L > K THEN 2200
2225 PRINT " TYPE IN EACH NEW CHORE AND PRESS ENTER."
2230 FOR I = W+1 TO W+L
2235   INPUT CH$(I)
2240 NEXT I
2245 W = W + L
2250 '
2255 GOSUB 1620
2260 IF A$ = "Y" THEN 2000
2265 RETURN
2270 '
2300 '
2330   PRINT"ENTER THE NUMBER OF THE CHORE TO BE DELETED."
2335   INPUT L
2340   FOR N = L TO W-1
2345     CH$(N-1) = CH$(N)
2355  NEXT N
2360 W = W-1
2363 CH$ = "
2370 '
2375 '
2380 GOSUB 1620
2385 IF A$ = "Y" THEN 2000
2390 RETURN
2395 '
2480 '
2500 ' THIS SECTION MAKES THE RANDON ASSIGNMENTS.
2502 FOR I = 0 TO 39:AS(I) = 0:NEXTI
2505 CLS:PRINT@535,"WORKING"
2507 G = 0
2510 FOR I = 0 TO W-1
2515   FLAG = 0:S = RND(0):S = INT (S*(W+1))
2520   FOR K = 0 TO W-1
2525     IF (S=AS(K)) FLAG = 1
2526     PRINT@139," FINDING AN ASSIGNMENT FOR ";CL$(G)
2530   NEXT K
2535   IF FLAG = 1 THEN 2515
2537 PRINT@165,"
2538 G = G + 1:IF G > J-1 THEN G = 0
2540 AS(I) = S:NEXT I
2545 '
2550 RETURN
3000 '    *** LIST  ASSIGNMENTS 10 AT A TIME. ***
3005 '
3010 CLS:L=0:F = 0
3015 N = J-1:CA = 0
3020 P = N: IF P >10 THEN P = 10
3025   FOR I = L TO P
3030      M = AS(CA)
```

```
3035     PRINT TAB(5):CL$(I):TAB(25):CH$(M)
3037    CA = CA + 1:IF CA > W-1 THEN CA = 0
3040   NEXT I
3045 PRINT:PRINT"    MORE ON NEXT PAGE":GOSUB 4000
3050 IF F = 1 THEN 3100
3055 N = N -10
3060 IF N < 10 THEN 3080
3065   L = P+1:P = P+10
3070   GOTO 3025
3075 '
3080 L = P+1:P = J-1:F = 1:GOTO 3025
3100 PRINT:PRINT"   PRESS S TO RELIST THE ASSIGNMENTS OR
     C TO CONTINUE."
3105 E$ = INKEY$: IF E$ <>"S" AND E$ <> "C" THEN 3105
3110 IF E$ = "S" THEN 3010
3115 RETURN
3500 CLS:PRINT@139,"ENTER  "
3505 PRINT"                1. TO REASSIGN THE CHORES."
3510 PRINT"                2. TO EXIT AND SAVE THE CHANGES."
3515 PRINT"                3. TO EXIT AND SAVE THE ORIGINAL DATA."
3517 PRINT"                4. TO EXIT AND LIST ON LINE PRINTER."
3520 INPUT A
3525 IF A<>1 AND A<>2 AND A<>3 AND A<>4 THEN 3500
3530 ON A GOTO 3550,3600,3550,3700
3550 RETURN
3600 OPEN "O",1,"CHORES/EMP"
3605 FOR I = 0 TO J-1
3610  PRINT#1,CL$(I)
3615 NEXT I
3616 CL$(J) = "END":PRINT#1,CL$(J)
3617 FOR I = 0 TO W-1
3618 PRINT #1,CH$(I):NEXTI
3619 CH$(W) = "END":PRINT#1,CH$(W)
3620 CLOSE
3625 RETURN
3700 'LIST ON LINE PRINTER
3705 '
3710 LPRINT CHR$(12)
3715   LPRINT TAB(25);" *****  CLASS CHORE ASSIGNMENTS *****"
3720 LPRINT" "
3725 FOR I = 0 TO W-1
3735   LPRINT TAB(15);CL$(I);TAB(50);CH$(AS(I))
3740 NEXTI
3742 LPRINT CHR$(12)
3745 RETURN
4000  ' ***********  WAIT FOR USER RESPONSE **********
4005 '
4010 PRINT@967,"PRESS C TO CONTINUE."
4015 S$=INKEY$:IF S$<>"C" THEN 4015
4020 RETURN
4025 '
4030 '
4200 '        *** USER INPUT ON CHANGE  ***
4205 '
4210 PRINT "ENTER P TO SEE MORE OF THE LIST OR C TO CHANGE
     AN ELEMENT SHOWN."
4215 AS$ = INKEY$: IF AS$<>"P" AND AS$<>"C" THEN4215
4220 RETURN
5000 END
```

```
10 ' DRILL-EXAMPLE DRILL AND PRACTICE PROGRAM
20 '
30 ' VOCABULARY DRILL-RANDOMIZED DEFINITIONS
40 ' WITH MULTIPLE CHOICE ANSWERS.
50 '
90 DIM Q$(100), A$(100), R1$(100), R2$(100), W1$(10), W2(10), J(5)
100 RANDOM
200 PRINT"HELLO I'M YOUR I.A. COMPUTER. WHAT IS YOUR NAME";
210 INPUT N$
215 PRINT:PRINT
220 READ N1
230 FOR I=1TON1
240 READ R1$(I), R2$(I), W1$(I), W2$(I)
250 NEXT I
260 READ N
270 FOR I= 1TO N
280 READ A$(I),Q$(I)
290 NEXT I
300 PRINT"O.K., ";N$;" WE'RE GOING TO DO A VOCABULARY DRILL."
310 PRINT"WOULD YOU LIKE TO REVIEW THE VOCABULARY FIRST (Y/N)?"
315 PRINT
320 R$=INKEY$:IFR$=""THEN320
330 IFR$ <>"Y"THEN 400
335 PRINT "PRESS <RETURN> AFTER EACH LINE"
336 PRINT
337 PRINT
340 PRINT "WORD","DEFINITION"
350 PRINT
360 FOR I = 1 TO N
370 PRINT A$(I), Q$(I)
380 INPUT R$
390 NEXT I
400 T = 0
410 R1 = 0
420 R2 = 0
430 PRINT "IN THE FOLLOWING, SELECT THE WORD (BY NUMBER <RETURN>)"
440 PRINT "THAT BEST FITS THE DEFINITION GIVEN. ENTER A ZERO ANSWER"
445 PRINT "TO STOP (0<RETURN>)."
450 '
460 '
470 GOSUB 1000
480 IF C1 < 0 GOTO 530
490 T = T + 1
500 R1 = R1 + C1
510 R2 = R2 + C2
520 GOTO 470
530 P1 = (100 * R1) / T
540 P2 = 100 * (R1 + R2)/T
550 S2 = R1 + R2
560 PRINT
570 PRINT"NO. QUESTIONS =";T,"NO. RIGHT =";R1
580 PRINT"NO. RIGHT IN TWO TRIES =";S2
590 PRINT "FIRST ANSWER PERCENTAGE =";P1
600 PRINT "TWO ANSWER PERCENTAGE =";P2
610 PRINT
620 PRINT
630 PRINT N$;", YOU CAN REPEAT THE REVIEW BY ENTERING R, OR REPEAT"
```

```
640 PRINT "THE DRILL BY ENTERING D. OTHERWISE, ENTER <RETURN>."
650 R$=INKEY$:IF R$ = "" THEN 650
660 IF R$ = "R" THEN 335
670 IF R$ = "D" THEN 400
680 PRINT
690 PRINT "BYE ";N$;", HAVE A GOOD DAY."
700 END
1000 ' DRILL SUBROUTINE - ASK VOCABULARY QUESTIONS
1010 '                                         SELLARS 7/82
1020 ' VOCABULARY IN A$(1)-A$(N), DEFINITIONS Q$(1)-Q$(N)
1030 ' RIGHT RESPONSES IN R1$(.), R2$(.), WRONG IN W1$(.),
1040 ' W2$(.), STUDENT NAME IN N$
1050 ' RETURNS          C1=1 IF FIRST ANSWER IS CORRECT
1060 '                  C2=1 IF SECOND ANSWER IS CORRECT
1070 '                  C1=-1 TO STOP SESSION
1100 PRINT
1110 PRINT
1120 FOR I = 1 TO 5
1130 J(I) = 0
1140 NEXT I
1150 K = INT((N * RND(0))+1)
1160 L = INT((5 * RND(0))+1)
1170 M = INT((N1 * RND(0))+1)
1180 J(L) = K
1190 FOR I = 1 TO 5
1200 IF J(I) <= 0 THEN J(I) = INT((N * RND(0))+1)
1205 NEXT I
1215 FOR I = 1 TO 4
1220 FOR L = I + 1 TO 5
1230 IF J(I) = J(L) THEN 1270
1240 NEXT L
1250 NEXT I
1260 GOTO 1290
1270 J(I) = 0
1280 GOTO 1180
1290 FOR I = 1 TO 5
1292 IF J(I) = K THEN L = I
1294 NEXT I
1300 PRINT Q$(K)
1310 PRINT
1320 PRINT "1 ";A$(J(1)),"2 ";A$(J(2))
1330 PRINT "3 ";A$(J(3)),"4 ";A$(J(4))
1340 PRINT "5 ";A$(J(5))
1350 INPUT X
1360 C1 = -1
1361 C2 = 0
1365 IF X <= 0 THEN RETURN
1367 C1 = 1
1370 IF X = L GOTO 1500
1375 C1 = 0
1376 C2 = 1
1380 IF RND(0) < .5 THEN 1410
1390 PRINT W1$(M);", ";N$;", ";W2$(M);". TRY AGAIN."
1400 GOTO 1420
1410 PRINT W1$(M);", ";N$;", ";W2$(M);", ". PICK ANOTHER."
1420 M = INT((N1 * RND(0))+1)
1430 INPUT X
```

```
1440 C2 = 1
1450 IF X = L THEN 1500
1460 C2 = 0
1470 PRINT W1$(M);", ";N$;", ";W2$(M)"."
1480 RETURN
1500 PRINT R1$(M);", ";N$;", ";R2$(M) ;"."
1510 RETURN
2000 ' REPLY STATEMENTS
2010 DATA 5
2020 DATA CORRECT,"THAT'S GOOD",INCORRECT,TOO BAD
2030 DATA "YOU'RE RIGHT",GOOD WORK,"YOU'RE WRONG","I'M SORRY"
2040 DATA ALRIGHT!,YOU GOT IT,SORRY,WRONG ANSWER
2050 DATA "YOU'RE DOING GOOD","",NOPE,"YOU DIDN'T GET IT"
2060 DATA "".YOU GOT IT!.STUDY HARDER,""
3000 '                        QUESTIONS AND ANSWERS
3010 DATA 15
3020 DATA ADDRESS,AN IDENTIFICATION THAT DESIGNATES A PARTICULAR
3030 DATA ARRAY,AN ORDERED ARRANGEMENT OR PATTERN OF ITEMS
3040 DATA BACKUP,A COPY OF A FILE OR DATA SET THAT IS KEPT
3050 DATA BIT,A BINARY DIGIT -- 1 OR 0.
3060 DATA BUFFER,A TEMPORARY STORAGE AREA THAT IS USED TO
          SPEEDS.
3070 DATA CHIP,A SMALL INTEGRATED CIRCUIT PACKAGE CONTAINING
3080 DATA CODING,THE WRITING OF A LIST OF INSTRUCTIONS THAT
          OPERATIONS.
3090 DATA DISKETTE,A LOW COST BULK STORAGE MEDIUM FOR
3100 DATA FILE,A COLLECTION OF RELATED RECORDS TREATED AS
3110 DATA GARBAGE,A TERM OFTEN USED TO DESCRIBE INCORRECT
3120 DATA INPUT.THE INTRODUCTION OF DATA FROM AN EXTERNAL
         STORAGE UNIT.
3130 DATA LOAD,TO READ INFORMATION INTO THE STORAGE OF A
3140 DATA MENU,A SET OF OPTIONS LISTED ON A TERMINAL.
3150 DATA NIBBLE.A GROUP OF FOUR BITS --- OR ONE-HALF OF A BYTE.
3160 DATA SOFTWARE.A SET OF PROGRAMS ---  PROCEDURES  ROUTINES
           OF A COMPUTER SYSTEM.
4000 END
```

The final program in the graphics section is "RESISTOR". This program reports the resistance, and the high and low tolerance of a resistor given the colors of it's bands. This program will draw a picture of a resistor and write out a menue of colors. then it will ask what the number of the color of band one is. When you enter a number the color for that number will be written in the first band, and so on for all four bands. When the program has done this it will output the results.

Before running this program you must run allocate. Here is a sample run and listing of the program.

The final program in the graphics section is "RESISTOR". This program reports the resistance, and the high and low tolerance of a resistor given the colors of it´s bands. This program will draw a picture of a resistor and write out a menue of colors. then it will ask what the number of the color of band one is. When you enter a number the color for that number will be written in the first band, and so on for all four bands. When the program has done this it will output the results.

Before running this program you must run allocate. Here is a sample run and listing of the program.

```
RUN ALLOCATE

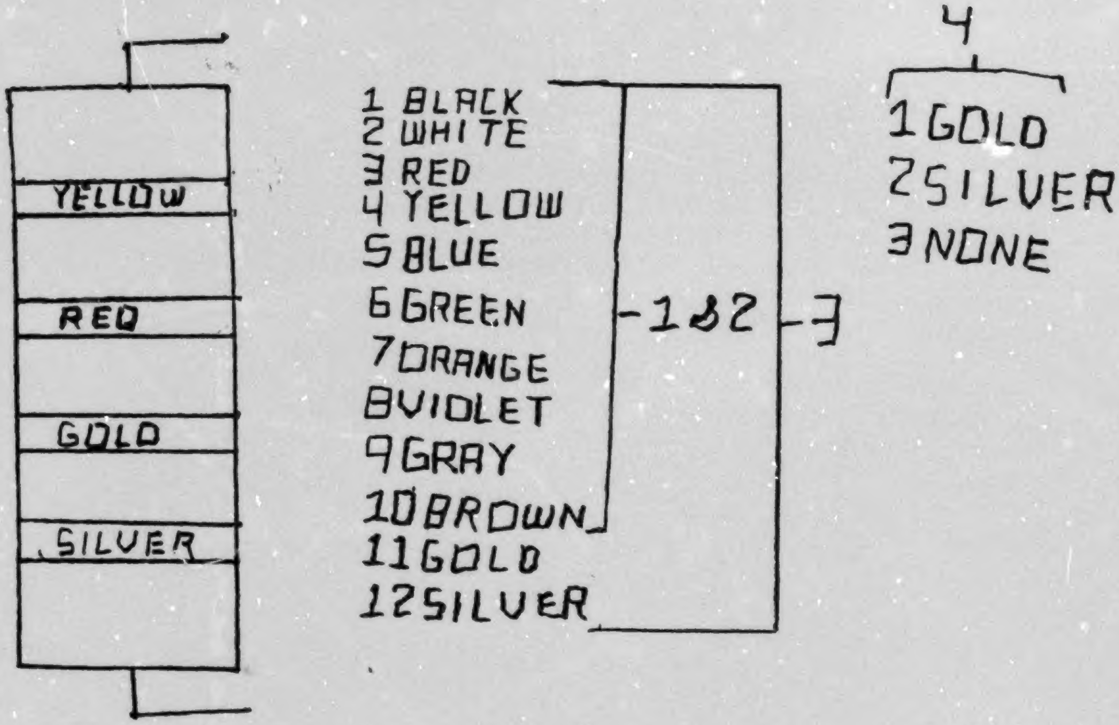
]RUN RESISTOR
ENTER THE COLOR OF BAND 1 ?4
ENTER THE COLOR OF BAND 2 ?3
ENTER THE COLOR OF BAND 3 ?11
ENTER THE COLOR OF BAND 4 ?2

THIS RESISTOR HAS A RESISTANCS OF 4.2 OHMS
WITH A HIGH TOLERANCE OF 4.62
AND A LOW TOLERANCE OF 3.78. <RETURN>?

]LIST

2  REM THIS IS A PROGRAM
4  REM TO TELL THE STUDENT
6  REM THE RESISTANCE OF A
8  REM RESISTOR GIVEN THE
10  REM COLOR OF IT'S BANDS
12  REM
20  HGR
30  REM DRAW THE RESISTOR
40  HPLOT 20,20 TO 80,20
50  HPLOT 50,20 TO 50,10
60  HPLOT 50,10 TO 80,10
70  HPLOT 20,20 TO 20,140
80  HPLOT 20,140 TO 80,140
90  HPLOT 80,140 TO 80,20
100  HPLOT 50,140 TO 50,150
110  HPLOT 50,150 TO 80,150
120  HPLOT 20,35 TO 80,35
130  HPLOT 20,45 TO 80,45
140  HPLOT 20,60 TO 80,60
150  HPLOT 20,70 TO 80,70
160  HPLOT 20,85 TO 80,85
170  HPLOT 20,95 TO 80,95
180  HPLOT 20,110 TO 80,110
190  HPLOT 20,120 TO 80,120
200  POKE 34,20
205  HOME
210  FOR I = 1 TO 4
220  PRINT "ENTER THE COLOR OF BA
     ND ";I;" ";
225 S = 0
230  IF I = 1 THEN  GOSUB 1000
240  IF I = 2 THEN  GOSUB 2000
250  IF I = 3 THEN  GOSUB 3000
260  IF I = 4 THEN  GOSUB 4000
265  NEXT I
267  PRINT
270 R = (A + B) * C
272 H = R + (R * D)
273 L = R - (R * D)
275  PRINT "THIS RESISTOR HAS A R
     ESISTANCS OF ";R;" OHMS"
280  PRINT "WITH A HIGH TOLERANCE
      OF ";H
285  PRINT "AND A LOW TOLERANCE O
```

BANDS


YELLOW
RED
GOLD
SILVER
1 BLACK
2 WHITE
3 RED
4 YELLOW
5 BLUE
6 GREEN
7 ORANGE
8 VIOLET
9 GRAY
10 BROWN
11 GOLD
12 SILVER
-1&2
-3
4
1 GOLD
2 SILVER
3 NONE

```
ENTER THE COLOR OF BAND 1? 4
ENTER THE COLOR OF BAND 2? 3
ENTER THE COLOR OF BAND 3? 11
ENTER THE COLOR OF BAND 4? 2
```

```
     F ";L;". <RETURN>";: INPUT A
     $
287  TEXT
290  END
1000 H = 120:V = 29: GOSUB 5000
1010 H = H + 12: GOSUB 35000
1020 H = 120:V = V + 10: GOSUB 60
     00
1030 H = H + 12: GOSUB 36000
1040 H = 120:V = V + 10: GOSUB 70
     00
1050 H = H + 12: GOSUB 37000
1060 H = 120:V = V + 10: GOSUB 80
     00
1070 H = H + 12: GOSUB 38000
1080 H = 120:V = V + 10: GOSUB 90
     00
1090 H = H + 12: GOSUB 39000
1100 H = 120:V = V + 10: GOSUB 10
     000
1110 H = H + 12: GOSUB 40000
1120 H = 120:V = V + 10: GOSUB 11
     000
1130 H = H + 12: GOSUB 41000
1140 H = 120:V = V + 10: GOSUB 12
     000
1150 H = H + 12: GOSUB 42000
1160 H = 120:V = V + 10: GOSUB 13
     000
1170 H = H + 12: GOSUB 43000
1180 H = 120:V = V + 10: GOSUB 50
     00
1190 H = H + 6: GOSUB 14000
1200 H = H + 12: GOSUB 44000
1205  IF S = 1 THEN  RETURN
1210  INPUT J
1220  IF J = 1 THEN A = 0
1230  IF J = 2 THEN A = 90
1240  IF J = 3 THEN A = 20
1250  IF J = 4 THEN A = 40
1260  IF J = 5 THEN A = 60
1270  IF J = 6 THEN A = 50
1280  IF J = 7 THEN A = 30
1290  IF J = 8 THEN A = 70
1300  IF J = 9 THEN A = 80
1310  IF J = 10 THEN A = 10
1320  IF J < 1 OR J > 10 THEN  PRINT
     "ILLEGAL ENTRY, TRY AGAIN";:
     GOTO 1210
1340 H = 35:V = 44
1350  GOSUB 48000
1450  RETURN
2000  INPUT J
2010  IF J = 1 THEN B = 0
2020  IF J = 2 THEN B = 9
2030  IF J = 3 THEN B = 2
2040  IF J = 4 THEN B = 4
2050  IF J = 5 THEN B = 6
```

```
2060  IF J = 6 THEN B = 5
2070  IF J = 8 THEN B = 7
2090  IF J = 9 THEN B = 8
2100  IF J = 10 THEN B = 1
2110  IF J < 1 OR J > 10 THEN  PRINT
     "ILLEGAL ENTRY, TRY AGAIN";:
      GOTO 2000
2130 H = 35:V = 69
2140  GOSUB 48000
2240  RETURN
3000 H = 120:V = 129: GOSUB 5000
3010 H = H + 6: GOSUB 5000
3020 H = H + 12: GOSUB 45000
3030 H = 120:V = V + 10: GOSUB 50
     00:H = H + 6: GOSUB 6000
3040 H = H + 12: GOSUB 46000
3050  INPUT J
3060  IF J < 1 OR J > 12 THEN  PRINT
     "ILLEGAL ENTRY, TRY AGAIN";:
      GOTO 3050
3080  IF J = 1 THEN C = 1
3090  IF J = 2 THEN C = 100000000
     0
3100  IF J = 3 THEN C = 100
3110  IF J = 4 THEN C = 10000
3120  IF J = 5 THEN C = 1000000
3130  IF J = 6 THEN C = 100000
3140  IF J = 7 THEN C = 1000
3150  IF J = 8 THEN C = 10000000
3160  IF J = 9 THEN C = 100000000

3170  IF J = 10 THEN C = 10
3180  IF J = 11 THEN C = .1
3190  IF J = 12 THEN C = .01
3200 H = 35:V = 94
3210  GOSUB 48000
3220  RETURN
4000 S = 1: HCOLOR= 4: GOSUB 1000

4010 H = 120:V = V + 10: GOSUB 50
     00:H = H + 6: GOSUB 5000
4020 H = H + 12: GOSUB 45000
4030 H = 120:V = V + 10: GOSUB 50
     00:H = H + 6: GOSUB 6000
4040 H = H + 12: GOSUB 46000
4050  HCOLOR= 3:H = 120:V = 29: GOSUB
     5000
4060 H = H + 12: GOSUB 45000
4070 H = 120:V = V + 10: GOSUB 60
     00
4080 H = H + 12: GOSUB 46000
4090 H = 120:V = V + 10: GOSUB 70
     00
4100 H = H + 12: GOSUB 47000
4110  INPUT J
4120  IF J < 1 OR J > 3 THEN  PRINT
     "ILLEGAL ENTRY, TRY AGAIN";:
      GOTO 4110
```

```
4140  IF J <  > 1 GOTO 4170
4150 J = 11
4160 D = .05
4170  IF J <  > 2 GOTO 4200
4180 J = 12
4190 D = .1
4200  IF J <  > 3 GOTO 4230
4210 J = 13
4220 D = .2
4230 H = 35:V = 119
4235  GOSUB 48000
4240  RETURN
5000  REM *** ONE ***
5010  HPLOT H,V - 6 TO H + 2,V -
     8
5020  HPLOT H + 2,V - 8 TO H + 2,
     V
5030  HPLOT H,V TO H + 4,V
5040  RETURN
6000  REM *** TWO ***
6010  HPLOT H,V - 6 TO H,V - 8
6020  HPLOT H,V - 8 TO H + 4,V -
     8
6030  HPLOT H + 4,V - 8 TO H + 4,
     V - 6
6040  HPLOT H + 4,V - 6 TO H,V -
     2
6050  HPLOT H,V - 2 TO H,V
6060  HPLOT H,V TO H + 4,V
6070  RETURN
7000  REM *** THREE ***
7010  HPLOT H,V - 8 TO H + 4,V -
     8 TO H + 4,V TO H,V
7020  HPLOT H + 4,V - 4 TO H,V -
     4
7030  RETURN
8000  REM *** FOUR ***
8010  HPLOT H,V - 8 TO H,V - 4
8020  HPLOT H,V - 4 TO H + 4,V -
     4
8030  HPLOT H + 3,V - 8 TO H + 3,
     V
8040  RETURN
9000  REM *** FIVE ***
9010  HPLOT H,V TO H + 4,V
9020  HPLOT H + 4,V TO H + 4,V -
     4
9030  HPLOT H + 4,V - 4 TO H,V -
     4
9040  HPLOT H,V - 4 TO H,V - 8
9050  HPLOT H,V - 8 TO H + 4,V -
     8
9060  RETURN
10000  REM *** SIX ***
10010  HPLOT H,V - 8 TO H + 4,V -
     8
10020  HPLOT H,V - 8 TO H,V
10030  HPLOT H,V TO H + 4,V
```

```
10040  HPLOT H + 4,V TO H + 4,V -
      4
10050  HPLOT H + 4,V - 4 TO H,V -
      4
10060  RETURN
11000  REM *** SEVEN ***
11010  HPLOT H,V - 8 TO H + 4,V -
      8 TO H,V
11030  RETURN
12000  REM *** EIGHT & B ***
12010  HPLOT H,V - 8 TO H + 4,V -
      8 TO H + 4,V TO H,V TO H,V -
      8
12030  HPLOT H,V - 4 TO H + 4,V -
      4
12040  RETURN
13000  REM *** NINE ***
13010  HPLOT H + 4,V - 4 TO H,V -
      4 TO H,V - 8 TO H + 4,V - 8 TO
      H + 4,V
13020  RETURN
14000  REM *** ZERO AND OH ***
14010  HPLOT H,V TO H + 4,V TO H +
      4,V - 8 TO H,V - 8 TO H,V
14020  RETURN
15000  REM *** A ***
15010  HPLOT H,V TO H,V - 8 TO H +
      4,V - 8 TO H + 4,V
15020  HPLOT H,V - 4 TO H + 4,V -
      4
15030  RETURN
16000  REM *** C ***
16010  HPLOT H + 4,V - 8 TO H,V -
      8 TO H,V TO H + 4,V
16020  RETURN
17000  REM *** D ***
17010  HPLOT H,V - 8 TO H,V TO H +
      2,V TO H + 4,V - 2 TO H + 4,
      V - 7 TO H + 3,V - 8 TO H,V -
      8
17020  RETURN
18000  REM *** E ***
18010  HPLOT H + 4,V - 8 TO H,V -
      8 TO H,V TO H + 4,V
18020  HPLOT H,V - 4 TO H + 4,V -
      4
18030  RETURN
19000  REM *** G ***
19010  HPLOT H + 4,V - 8 TO H,V -
      8 TO H,V TO H + 4,V TO H + 4
      ,V - 4 TO H + 2,V - 4
19020  RETURN
20000  REM *** H ***
20010  HPLOT H,V - 8 TO H,V
20020  HPLOT H + 4,V - 8 TO H + 4
      ,V
20030  HPLOT H,V - 4 TO H + 4,V -
      4
```

```
20040  RETURN
21000  REM *** I ***
21010  HPLOT H + 2,V - 8 TO H + 2
     ,V
21020  RETURN
22000  REM *** K ***
22010  HPLOT H,V - 8 TO H,V
22020  HPLOT H + 4,V - 8 TO H,V -
     4 TO H + 4,V
22030  RETURN
23000  REM *** L ***
23010  HPLOT H,V - 8 TO H,V TO H +
     4,V
23020  RETURN
24000  REM *** N ***
24010  HPLOT H,V TO H,V - 8 TO H +
     4,V TO H + 4,V - 8
24020  RETURN
25000  REM *** R ***
25010  HPLOT H,V TO H,V - 8 TO H +
     4,V - 8 TO H + 4,V - 4 TO H,
     V - 4
25020  HPLOT H + 2,V - 4 TO H + 4
     ,V
25030  RETURN
26000  REM *** S ***
26010  HPLOT H + 4,V - 8 TO H,V -
     8 TO H,V - 4 TO H + 4,V - 4 TO
     H + 4,V TO H,V
26020  RETURN
27000  REM *** T ***
27010  HPLOT H,V - 8 TO H + 4,V -
     8
27020  HPLOT H + 2,V - 8 TO H + 2
     ,V
27030  RETURN
28000  REM *** U ***
28010  HPLOT H,V - 8 TO H,V TO H +
     4,V TO H + 4,V - 8
28020  RETURN
29000  REM *** V ***
29010  HPLOT H,V - 8 TO H,V - 4 TO
     H + 2,V TO H + 4,V - 4 TO H +
     4,V - 8
29020  RETURN
30000  REM *** W ***
30010  HPLOT H,V - 8 TO H,V TO H +
     4,V TO H + 4,V - 8
30020  HPLOT H + 2,V TO H + 2,V -
     8
30030  RETURN
31000  REM *** Y ***
31010  HPLOT H,V - 8 TO H + 2,V -
     4 TO H + 4,V - 8
31020  HPLOT H + 2,V - 4 TO H + 2
     ,V
31030  RETURN
35000  REM *** BLACK ***
```

```
35010  GOSUB 12000
35020 H = H + 6: GOSUB 23000
35030 H = H + 6: GOSUB 15000
35040 H = H + 6: GOSUB 16000
35050 H = H + 6: GOSUB 22000
35060 H = H - 24: RETURN
36000  REM *** WHITE ***
36010  GOSUB 30000
36020 H = H + 6: GOSUB 20000
36030 H = H + 6: GOSUB 21000
36040 H = H + 6: GOSUB 27000
36050 H = H + 6: GOSUB 18000
36060 H = H - 24: RETURN
37000  REM *** RED ***
37010  GOSUB 25000
37020 H = H + 6: GOSUB 18000
37030 H = H + 6: GOSUB 17000
37040 H = H - 12: RETURN
38000  REM *** YELLOW ***
38010  GOSUB 31000
38020 H = H + 6: GOSUB 18000
38030 H = H + 6: GOSUB 23000
38040 H = H + 6: GOSUB 23000
38050 H = H + 6: GOSUB 14000
38060 H = H + 6: GOSUB 30000
38070 H = H - 30: RETURN
39000  REM *** BLUE ***
39010  GOSUB 12000
39020 H = H + 6: GOSUB 23000
39030 H = H + 6: GOSUB 28000
39040 H = H + 6: GOSUB 18000
39050 H = H - 18: RETURN
40000  REM *** GREEN ***
40010  GOSUB 19000
40020 H = H + 6: GOSUB 25000
40030 H = H + 6: GOSUB 18000
40040 H = H + 6: GOSUB 18000
40050 H = H + 6: GOSUB 24000
40060 H = H - 24: RETURN
41000  REM *** ORANGE ***
41010  GOSUB 14000
41020 H = H + 6: GOSUB 25000
41030 H = H + 6: GOSUB 15000
41040 H = H + 6: GOSUB 24000
41050 H = H + 6: GOSUB 19000
41060 H = H + 6: GOSUB 18000
41070 H = H - 30: RETURN
42000  REM *** VIOLET ***
42010  GOSUB 29000
42020 H = H + 6: GOSUB 21000
42030 H = H + 6: GOSUB 14000
42040 H = H + 6: GOSUB 23000
42050 H = H + 6: GOSUB 18000
42060 H = H + 6: GOSUB 27000
42070 H = H - 30: RETURN
43000  REM *** GRAY ***
43010  GOSUB 19000
43020 H = H + 6: GOSUB 25000
```

```
43030 H = H + 6: GOSUB 15000
43040 H = H + 6: GOSUB 31000
43050 H = H - 18: RETURN
44000  REM *** BROWN ***
44010  GOSUB 12000
44020 H = H + 6: GOSUB 25000
44030 H = H + 6: GOSUB 14000
44040 H = H + 6: GOSUB 30000
44050 H = H + 6: GOSUB 24000
44060 H = H - 24: RETURN
45000  REM *** GOLD ***
45010  GOSUB 19000
45020 H = H + 6: GOSUB 14000
45030 H = H + 6: GOSUB 23000
45040 H = H + 6: GOSUB 17000
45050 H = H - 18: RETURN
46000  REM *** SILVER ***
46010  GOSUB 26000
46020 H = H + 6: GOSUB 21000
46030 H = H + 6: GOSUB 23000
46040 H = H + 6: GOSUB 29000
46050 H = H + 6: GOSUB 18000
46060 H = H + 6: GOSUB 25000
46070 H = H - 30: RETURN
47000  REM *** NONE ***
47010  GOSUB 24000
47020 H = H + 6: GOSUB 14000
47030 H = H + 6: GOSUB 24000
47040 H = H + 6: GOSUB 18000
47050 H = H - 18: RETURN
48000  IF J = 1 THEN  GOSUB 35000

48010  IF J = 2 THEN  GOSUB 36000

48020  IF J = 3 THEN  GOSUB 37000

48030  IF J = 4 THEN  GOSUB 38000

48040  IF J = 5 THEN  GOSUB 39000

48050  IF J = 6 THEN  GOSUB 40000

48060  IF J = 7 THEN  GOSUB 41000

48070  IF J = 8 THEN  GOSUB 42000

48080  IF J = 9 THEN  GOSUB 43000

48090  IF J = 10 THEN  GOSUB 4400
    0
48100  IF J = 11 THEN  GOSUB 4500
    0
48110  IF J = 12 THEN  GOSUB 4600
    0
48120  IF J = 13 THEN  GOSUB 4700
    0
48130  RETURN
```

```
100  REM * RESISTOR CODE *
110  REM *   F. MULLEN   *
120  REM *   TAIU 1984   *

130  TEXT : HOME : CLEAR
140  GOSUB 1000
150  PRINT  TAB( 10)"RESISTOR VALUE FINDER"
160  PRINT : PRINT " ENTER THE PAIR OF LETTERS THAT MATCH"
170  PRINT "EACH COLORED BAND ON THE RESISTOR:"
180  PRINT : PRINT "(BL) BLACK     (BR) BROWN     (RD) RED"
190  PRINT "(OR) ORANGE    (YL) YELLOW    (GN) GREEN"
200  PRINT "(BU) BLUE      (VI) VIOLET    (GR) GRAY"
210  PRINT "(WH) WHITE     (SL) SILVER    (GO) GOLD"
220  PRINT "               (NO) NONE"
230  C = C + 1
240  PRINT : INPUT "FIRST COLOR BAND ---> ";CB$(C)
250  GOSUB 700
260  C = C + 1
270  INPUT "SECOND COLOR BAND --> ";CB$(C)
280  GOSUB 700
290  C = C + 1
300  INPUT "THIRD COLOR BAND ---> ";CB$(C)
310  GOSUB 700
320  INPUT "FOURTH COLOR BAND --> ";TB$
330  IF TB$ = "NO" THEN VT = .2:T$ = "+-20%": GOTO 400
340  IF TB$ = "SL" THEN VT = .1:T$ = "+-10%": GOTO 400
350  IF TB$ = "GO" THEN VT = .05:T$ = "+-5%": GOTO 400
360  GOSUB 740

400  REM CALCULATION
410  V1$ =  STR$ (V(1))
420  IF V1$ = "0" THEN V1$ = ""
430  V2$ =  STR$ (V(2))
440  V$ = V1$ + V2$
450  IF V(3) = 0 THEN 470
460  FOR X = 1 TO V(3):V$ = V$ + "0": NEXT
470  V =  VAL (V$)
480  GOSUB 800
490  PRINT : PRINT
500  PRINT "RESISTOR VALUE --> "NV$" OHMS"
510  PRINT "TOLERANCE -------> "T$
520  HV = V + (V * VT)
530  HV =  INT (HV * 10 + .5) / 10
540  V$ =  STR$ (HV)
550  GOSUB 800
560  PRINT : PRINT "HIGHEST VALUE ---> "NV$" OHMS"
570  LV = V - (V * VT)
580  LV =  INT (LV * 10 + .5) / 10
590  V$ =  STR$ (LV)
600  GOSUB 800
```

```
610  PRINT "LOWEST VALUE ----> "NV$" OHMS"
620  PRINT : INPUT "ANOTHER PROBLEM ? (Y/N) ";A$
630  IF  LEFT$ (A$,1) = "N" THEN  HOME : END
640  GOTO 130

700  REM  FIND VALUE
710  FOR X = 1 TO 10
720  IF CB$(C) = C$(X) THEN V(C) = VC(X): RETURN
730  NEXT
740  PRINT : PRINT  CHR$ (7)" - TRY AGAIN - "
750  FOR Z = 0 TO 1500: NEXT
760  POP : GOTO 130

800  REM FORMAT NUMBERS
810  NV$ = "":D$ = ""
820  L =  LEN (V$)
830  IF L <  = 2 THEN NV$ = V$: GOTO 980
840  IF  MID$ (V$,L - 1,1) = "." THEN 860
850  GOTO 880
860  D$ =  RIGHT$ (V$,2)
870  V$ =  LEFT$ (V$,L - 2)
880  L =  LEN (V$)
890  IF L <  = 3 THEN NV$ = V$: GOTO 980
900  FOR X = 2 TO L STEP 3
910  B$ =  MID$ (V$,L - X,3)
920  IF L - X <  = 3 THEN NV$ = B$ + NV$: GOTO 950
930  NV$ = "," + B$ + NV$
940  NEXT
950  C$ =  MID$ (V$,1,L - X - 1)
960  IF C$ = "" THEN 980
970  NV$ = C$ + "," + NV$
980  NV$ = NV$ + D$
990  RETURN

1000  REM INIT ARRAYS
1010  FOR X = 1 TO 10: READ C$(X): NEXT
1020  FOR X = 1 TO 10: READ VC(X): NEXT
1030  DATA BL,BR,RD,OR,YL,GN,BU,VI,GR,WH
1040  DATA 0,1,2,3,4,5,6,7,8,9
1050  RETURN
```

```
1 REM ************************************************************************
2 REM                          VIC 20 ROCKET DATA PROGRAM
3 REM ************************************************************************
10 D$="ROCKET DATA SHEET PERIOD "
15 E$="NAME ROCKET HEIGHT (FT) TOTAL FLIGHT TIME (SEC)"
20 POKE36879,25
25 PRINT"█" TAB(1)"██████ROCKET DATA MONITOR ██"
30 PRINT TAB(3)"COPYRIGHT 1984 ██"
35 PRINT TAB(2)"SMART ELECTRONICS"
40 T=TI
45 IF TI<T+180 THEN 45
50 GOSUB 500
55 PRINT TAB(0)"███ BASELINE (FT) ";
60 INPUT B
65 PRINT TAB(0)"███ CLASS PERIOD ";
70 INPUT C
75 PRINT TAB(0)"███ READOUT: (P/S)";
80 INPUT A$
85 IF A$="P" THEN 100
90 IF A$="S" THEN 125
95 GOTO 75
100 OPEN4,4: PRINT#4, CHR$(14) TAB(6) D$;C
105 PRINT#4
110 PRINT#4
115 PRINT#4,CHR$(15)LEFT$(E$,4)TAB(17)MID$(E$,6,18)TAB(10)RIGHT$(E$,
    16):PRINT#4
120 CLOSE4,4
125 GOSUB500
130 PRINT TAB(0)"███STUDENT NAME (LAST)█"
135 PRINT TAB(0): INPUT N$
140 IF N$="END" THEN END
145 PRINT TAB(0)"█(F1) START CLOCK"
150 PRINT TAB(0)"(F7) STOPS CLOCK"
155 GET I$: IF I$="" THEN 155
160 IF I$=CHR$(133) THEN 169
165 GOTO 155
169 TI$="000000"
170 X=INT ((TI*100)/60)
173 Y=X/100
175 PRINT "██████████████████" TAB(0)"FLIGHT TIME:"Y
180 GET I$:IF I$=CHR$(136) THEN 190
185 GOTO 170
190 PRINT TAB(0)"██ROCKET ANGLE:";
195 INPUT R
197 IF  R=0 THEN 125
200 IF R>90 THEN 195
205 REM TAN CALCULATION
210 H=INT((TAN(R/57.29578)*B)+.55)
215 IF A$="S" THEN 800

READY.
```

```
220 OPEN4,4
225 PRINT#4,CHR$(16)"00"N$;
230 PRINT#4,CHR$(16)"22"H;
235 PRINT#4,CHR$(16)"49"Y
237 PRINT#4
240 CLOSE4,4
245 GOTO 125
500 PRINT"[redacted]"
505 PRINT TAB(1)"[redacted]ROCKET DATA MONITOR[redacted]"
510 PRINT"[redacted]"
515 RETURN
800 GOSUB 500
805 PRINT TAB(0)"[redacted]NAME: "N$
810 PRINT TAB(0)"[redacted]HEIGHT (FT): "H
815 PRINT TAB(0)"[redacted]TIME  (SEC): "Y
820 GET I$: IF I$="" THEN 820
825 GOTO 125
900 REM ***********************************************************************
910 REM                      JOHN SMART
920 REM                      3707 WINDMILL LA.
930 REM                      PLANO, TX 75075
READY.
```

```
1 REM ***************************************************************
2 REM                         64  ROCKET DATA PROGRAM
3 REM ***************************************************************
10 D$="ROCKET DATA SHEET PERIOD "
15 E$="NAME ROCKET HEIGHT (FT) TOTAL FLIGHT TIME (SEC)"
20 POKE53281,15: POKE53280,15: REM COLOR CHANGE
25 PRINT"██" TAB(9)"██████████ ROCKET DATA MONITOR ██"
30 PRINT TAB(13)"COPYRIGHT 1984 ██"
35 PRINT TAB(11)"SMART ELECTRONICS"
40 T=TI
45 IF TI<T+180 THEN 45
50 GOSUB 500
55 PRINT TAB(3)"███ BASELINE (FT) ";
60 INPUT B
65 PRINT TAB(3)"███ CLASS PERIOD ";
70 INPUT C
75 PRINT TAB(3)"███ READOUT:PRINTER OR SCREEN (P/S)";
80 INPUT A$
85 IF A$="P" THEN 100
90 IF A$="S" THEN 125
95 GOTO 75
100 OPEN4,4: PRINT#4, CHR$(14) TAB(6) D$;C
105 PRINT#4
110 PRINT#4
115 PRINT#4,CHR$(15)LEFT$(E$,4)TAB(17)MID$(E$,6,18)TAB(10)RIGHT$(E$,
    16):PRINT#4
120 CLOSE4,4
125 GOSUB500
130 PRINT TAB(3)"███ STUDENT NAME (LAST)█"
135 PRINT TAB(3): INPUT N$
140 IF N$="END" THEN END
145 PRINT TAB(1)"███ TO START CLOCK HIT FUNCTION KEY (F1)"
150 PRINT TAB(1)" TO STOP CLOCK HIT FUNCTION KEY (F7)"
155 GET I$: IF I$="" THEN 155
160 IF I$=CHR$(133) THEN 169
165 GOTO 155
169 TI$="000000"
170 X=INT ((TI*100)/60)
173 Y=X/100
175 PRINT "██████████████████████" TAB(3)" FLIGHT TIME (SEC): "Y
180 GET I$:IF I$=CHR$(136) THEN 190
185 GOTO 170
190 PRINT TAB(3)"██ ROCKET ANGLE (DEG) ";
195 INPUT R
197 IF  R=0 THEN 125
200 IF R>90 THEN 195
205 REM TAN CALCULATION
210 H=INT((TAN(R/57.29578)*B)+.55)
215 IF A$="S" THEN 800

READY.
```

```
220 OPEN4,4
225 PRINT#4,CHR$(16)"00"N$;
230 PRINT#4,CHR$(16)"22"H;
235 PRINT#4,CHR$(16)"49"Y
237 PRINT#4
240 CLOSE4,4
245 GOTO 125
500 PRINT"███████████████████████████"
505 PRINT TAB(10)"ROCKET DATA MONITOR█"
510 PRINT"███████████████████████████"
515 RETURN
800 GOSUB 500
805 PRINT TAB(5)"██ STUDENT NAME: "N$
810 PRINT TAB(5)"██ ROCKET HEIGHT (FT): "H" FT"
815 PRINT TAB(5)"██ FLIGHT TIME (SEC): "Y"
820 GET I$: IF I$="" THEN 820
825 GOTO 125
900 REM ****************************************************************
910 REM                        JOHN SMART
920 REM                        3707 WINDMILL LA.
930 REM                        PLANO, TX 75075
940 REM ****************************************************************
READY.
```

```
5 REM ************************************************************************
10 REM               VIC 20 OPTO LAUNCH PROGRAM
15 REM ***********************************************************************
20 DDR=37138:REM DATA DIRECTIONN REGISTER PORT B
21 DB=37136:REM DATA REGISTER PORT B
22 RS=255:REM RESET VALUE
23 SU=191:REM BIT 6 INPUT VALUE
24 L=128:REM BIT 7 VALUE
25 V=64:REM BIT 6 VALUE
30 POKE36879,25
35 PRINT"[redacted]LAUNCH CONTROL MONITOR[redacted]"
40 PRINT"[redacted]COPYRIGHT 1984[redacted]"
45 PRINT"[redacted]SMART ELECTRONICS"
50 I=TI
55 IFTI<I+180THEN55
60 POKEDB,RS:REM PLACE HIGH AT ALL BITS
65 POKEDDR,SU:REM REM SET BIT 6 FOR INPUT OTHER TO OUTPUT
70 PRINT"[redacted]"
75 PRINT"LAUNCH CONTROL MONITOR"
80 PRINT"[redacted]"
85 PRINT"[redacted]LAUNCH PAD NUMBER";
90 INPUTP: IFP>5THEN60
100 J=P
105 IFJ=0THEN POKEDB,SU:END
110 IFJ=1THENP=1
115 IFJ=2THENP=2
120 IFJ=3THENP=4
125 IFJ=4THENP=8
130 IFJ=5THENP=16
135 POKEDB,(PEEK(DB)ANDNOTP):REMCLOSES SELECTED RELAY
140 FORD=1TO100:NEXTD:REM DELAY TO ALLOW RELAY TO CLOSE
145 IF PEEK(DB)<>(RS-P)-VTHEN500:REM CHECKES IGNITER CONNECTION
150 PRINT"[redacted]SYSTEM ON PAD"J"OK"
155 PRINT"[redacted]TIME TO LIFT OFF";
160 INPUTT
165 FORC=TTO0 STEP-1
167 IFC<10THENPOKE38772,1:POKE8052,244
170 Q=TI
175 GETM$:IFM$=""THEN185:REM CKECK KEYBOARD
180 IFM$=CHR$(133)THEN60
185 PRINT"[redacted]TIME TO LIFT OFF ";C
190 IF PEEK(DB)<>(RS-P)-VTHEN500
195 GOSUB600
200 IFTI<Q+60THEN200
205 NEXTC
210 GOSUB700
215 GOTO60

READY.
```

```
500 REM SYSTEM SHUT DOWN ROUTINE
505 PRINT"██SYSTEM SHUT DOWN PAD"J
510 POKEDB,RS:REM RESET RELAYS
513 POKE36878,0:REM TURN OFF VOLUME
515 PRINT"SYSTEM REPARIED Y/N";
520 INPUTR$
525 IFR$="Y"THEN60
530 GOTO520
600 REM SOUND ROUTINE
610 POKE36878,15
615 POKE36875,240
620 FORN=1TO150:NEXTN
625 POKE36878,0
630 RETURN
700 REM LAUNCHING ROUTINE
705 PRINT"██ROCKET LAUNCHING"
710 Q=TI
715 POKEDB,(PEEK(DB)ANDNOTL):REM CLOSE LAUNCH RELAY BIT 7
720 IFTI<Q+180THEN720:REM 3 SEC DELAY
725 POKEDB,RS:REM RESET ALL RELAYS
730 RETURN
800 REM *****************************************************************
810 REM                     JOHN SMART
820 REM                     3707 WINDMILL LA.
830 REM                     PLANO, TX 75075
840 REM*******************************************************************
READY.
```

```
5 REM ***********************************************************************
10 REM                  64 OPTO LAUNCH PROGRAM
15 REM ***********************************************************************
20 DDR=56579: REM DATA DIRECTION REGISTER PORT B
21 DB=56577: REM DATA REGISTER PORT B
22 RS=255: REM RESET VALUE
23 SU=191: REM BIT 6 INPUT VALUE
24 L=128: REM BIT 7 VALUE
25 V=64: REM BIT 6 VALUE
26 S=54272: REM START SOUND LOCATION
27 FOR G=S TO S+24: POKEG,0:NEXTG
30 POKE53281,15: POKE53280,15: REM COLOR CHANGE
35 PRINT"⊔"TAB(9)"[redacted] LAUNCH CONTROL MONITOR [redacted]"
40 PRINT TAB(13)"COPYRIGHT 1984 [redacted]"
45 PRINT TAB(11)"SMART ELECTRONICS"
50 I=TI
55 IF TI<I+180 THEN 55
60 POKEDB,RS: REM PLACE HIGH AT ALL BITS
65 POKEDDR,SU: REM SET BIT 6 FOR INPUT OTHERS TO OUTPUT
66 POKES+24,0
70 PRINT"⊔[redacted]"
75 PRINT TAB(9)"LAUNCH CONTROL MONITOR [redacted]"
80 PRINT"[redacted]"
85 PRINT TAB(5)"[redacted] LAUNCH PAD NUMBER";
90 INPUT P: IF P>5 THEN 60
100 J=P
105 IF J=0 THEN POKEDB,SU: END
110 IF J=1 THEN P=1
115 IF J=2 THEN P=2
120 IF J=3 THEN P=4
125 IF J=4 THEN P=8
130 IF J=5 THEN P=16
135 POKEDB,(PEEK(DB) AND NOT P): REM CLOSES SELECTED RELAY
140 FOR D=1 TO 100: NEXTD:REM DELAY TO ALLOW RELAY TO CLOSE
145 IF PEEK(DB)<>(RS-P)-V THEN 500: REM CHECKES IGNITER CONNECTION
150 PRINT TAB(5)"[redacted] ALL SYSTEMS ON PAD"J"OK"
155 PRINT TAB(5)"[redacted] TIME TO LIFT OFF";
160 INPUT T
162 POKES+24,15
165 FOR C=T TO 0 STEP -1
167 IF C<10 THEN POKE56121,15:POKE1849,160
170 Q=TI
175 GET M$: IF M$="" THEN 185: REM CHECKES KEYBOARD FOR INPUT
180 IF M$=CHR$(133) THEN 60
185 PRINT"[redacted] " TAB(5)" TIME TO LIFT OFF ";C
190 IF PEEK(DB)<>(RS-P)-V THEN 500
195 GOSUB 600
200 IF TI<Q+60 THEN 200
205 NEXTC
210 GOSUB 700
215 GOTO60

READY.
```

```
500 REM SYSTEM SHUT DOWN ROUTINE
505 PRINT TAB(5)"█ SYSTEM SHUT DOWN PAD";J
510 POKEDB,RS: REM RESET RELAYS
513 POKES+24,0: REM TURN OFF SOUND
515 PRINT TAB(5)"█ HAS SYSTEM BEEN REPAIRED (Y/N)";
520 INPUT R$
525 IF R$="Y" THEN 60
530 GOTO 520
600 REM SOUND ROUTINE
605 POKES+5,4:POKES+6,3: REM SET ATT/DECY
610 POKES+1,67: REM SET HIGH NOTE
615 POKES,15: REM SET LOW NOTE
620 POKES+4,17: REM TURN ON WAVEFORM
625 FOR K=1 TO 100: NEXT K
630 POKES+4,16
635 RETURN
700 REM LAUNCHING ROUTINE
705 PRINT TAB(5)"██ ROCKET LAUNCHING"
710 Q=TI
715 POKEDB,(PEEK(DB) AND NOT L): REM CLOSES LAUNCH RELAY BIT 7
720 IF TI<Q+180 THEN 720: REM 3 SEC DELAY
725 POKEDB,RS: REM RESET ALL RELAYS
730 RETURN
750 REM*******************************************************************
755 REM                   JOHN SMART
760 REM                   3703 WINDMILL LA.
765 REM                   PLANO, TX 75075
770 REM*******************************************************************
READY.
```

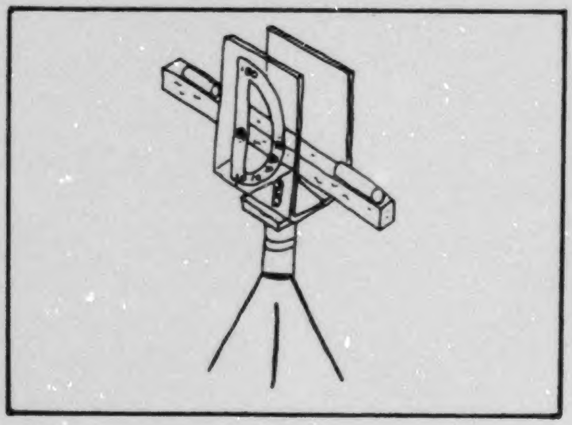
ANGULAR TRACKER

The angular tracker is made with a six-inch protractor mounted on the side of a 1" x 3/4" x 16" piece of wood. Placed on top of the wood are two sights made from 4" x 1/4" tubes located at the front and rear of the wooden strip. This unit is then mounted between a U-shaped section of clear plexaglass. A zero mark is then scratched in the plexaglass for zeroing and reading of the measured angle. This unit is then placed on top of a tripod for support and mobility.

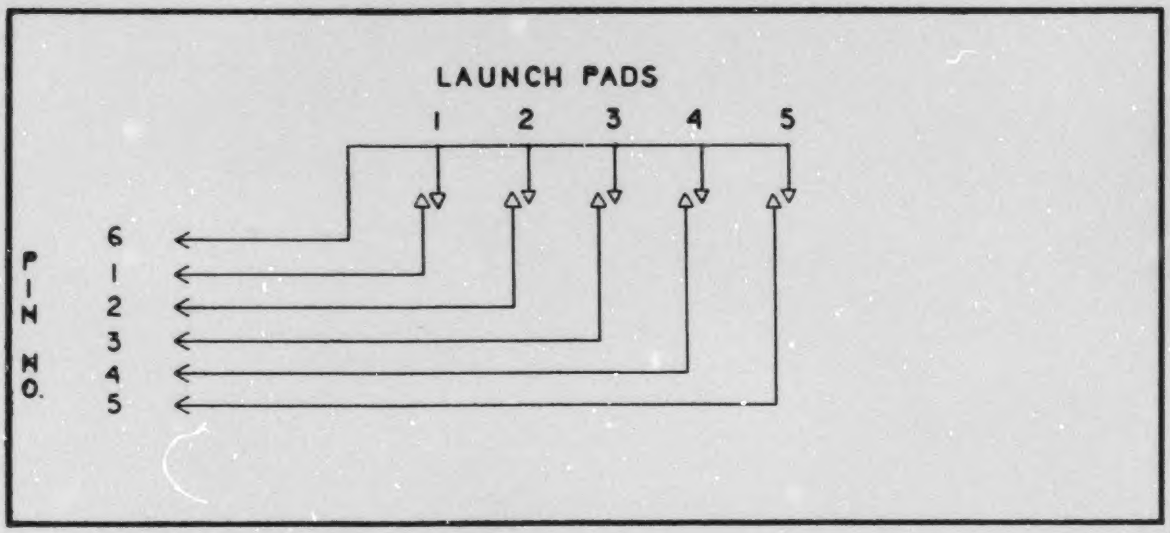
The operation of this device is based upon a trigonometry formula that states if the length of a triangle's base is known and the tangent of its angle is known, the height can be calculated. For our purposes, the formula looks like this: Height = (baseline distance) x (tan angle). Before the launch, the base line for the tracking device was measured out and marked. This distance should be equal to or greater than the expected height of the rockets.

Before the launch, the two members of the tracking team transported the unit to the marker. The main operator set up the unit and zeroed the unit to the base of the launch pad. The other member placed himself in position at the side of the unit to read the angle and then radio the result back to the data operator.

This method of altitude prediction is not perfect, but if care is taken in the set up and in its operation, close approximations can be obtained.



LAUNCH PAD CONNECTOR ASSEMBLY



1 () Construct a wiring harness for the 5 pad launcher, leaving approximately 8 inches extending over the end for the launch pad connector.

2 () Connect ignitor clips to the wiring harness.

3 () Place the end of the harness through the launch pad connector cover.

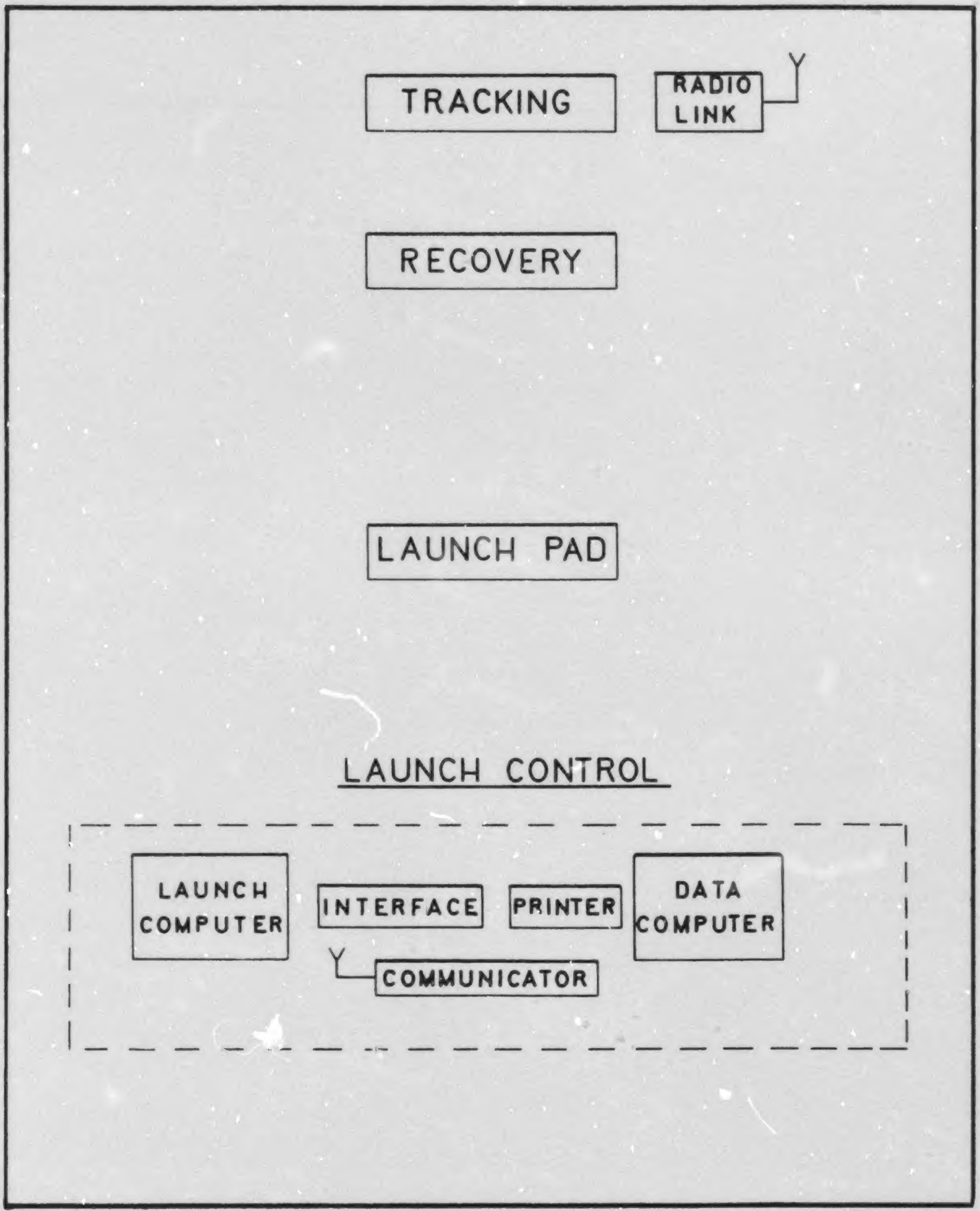
4 () Remove 1/8 in. insulation from each of the wires.

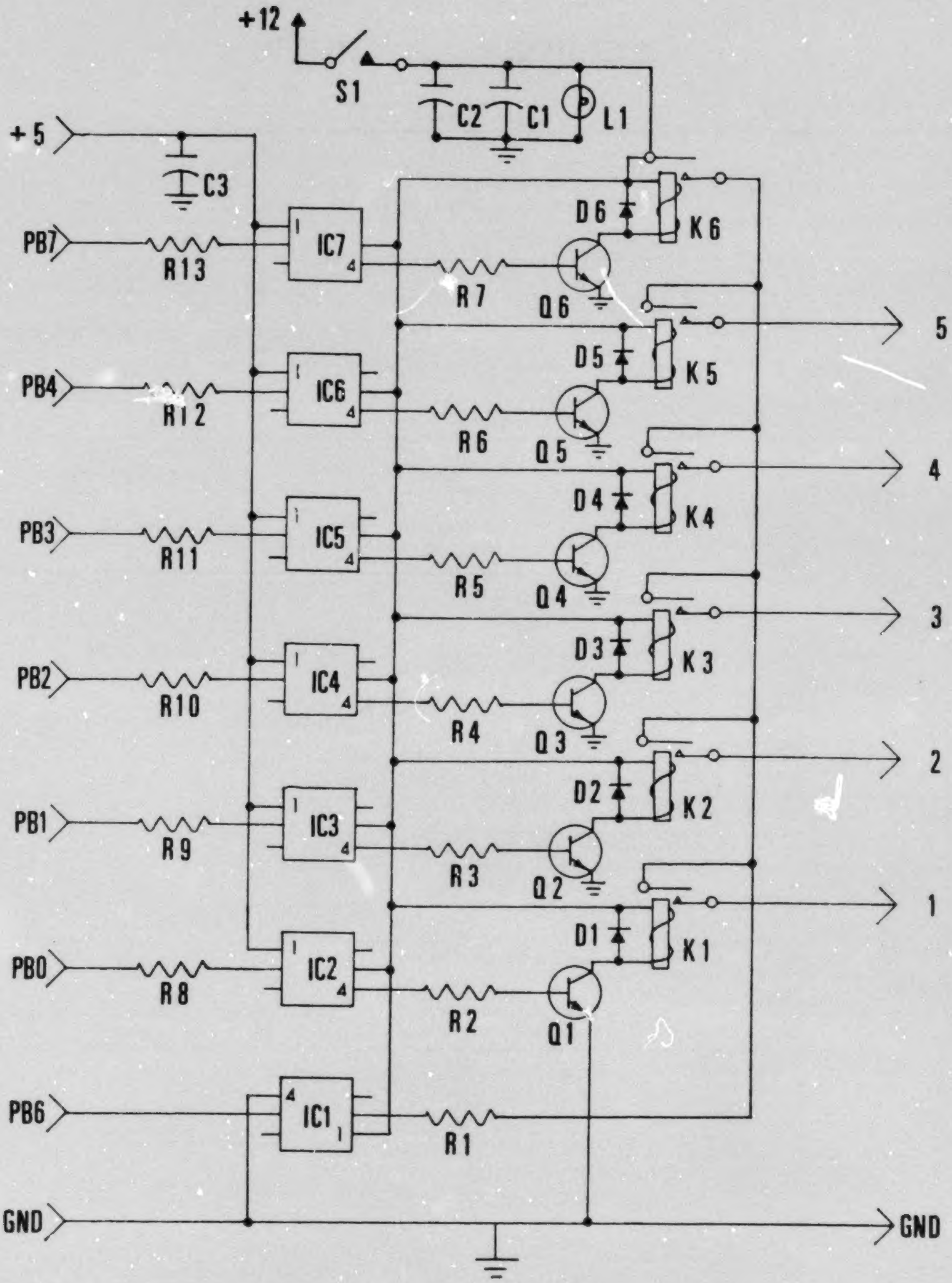
5 () Use a small amount of solder and tin the wires and the pins of the male connector.

6 () Solder the wire to the pins as shown in the above diagram.

7 () Place the cover over the connector and insert the holding pin, then tighten the strain relief screws.

LAUNCH COMPLEX


TRACKING
RADIO LINK
RECOVERY
LAUNCH PAD
LAUNCH CONTROL
LAUNCH COMPUTER
INTERFACE
PRINTER
DATA COMPUTER
COMMUNICATOR


+12
S1
C2
C1
L1
+5
C3
PB7
R13
IC7
R7
D6
K6
Q6
5
PB4
R12
IC6
R6
D5
K5
Q5
4
PB3
R11
IC5
R5
D4
K4
Q4
3
PB2
R10
IC4
R4
D3
K3
Q3
2
PB1
R9
IC3
R3
D2
K2
Q2
1
PB0
R8
IC2
R2
D1
K1
Q1
PB6
IC1
R1
GND
GND

ROCKET LAUNCHER INTERFACE L2 SMART © 1984

ROCKET LAUNCHER L2 PARTS LIST

NO.	PART	DESCRIPTION	UNIT	TOTAL
1	R1	1kohm Resistor		
3	RN	1kohm Resistor Network		
1	C1	10mf Capacitor		
2	C2, C3	.1 mf Capacitor		
6	D1-D6	1N4001 Diode		
6	Q1-Q6	2N2222 Transistor		
7	IC1-7	4N26 Optocoupler		
6	K1-K6	12V 300ohm 3Amp Relay		
1	L1	12 Volt Lamp		
1	S1	SPST Key Switch		
1	PCB	Printed Circuit Board (PCB)		
1	CAB	Metal Cabinet		
1	CEC	12/24 Card Edge Connector		
1	BSC	Backshell Cover		
1	MJC	6 pin Male Jones Connector		
1	FJC	6 pin Female Jones Connector		
2	BC	Battery Clip		
3	RG	Rubber Grommet		
4	ST	PCB Standoff		
4	SC	1 in. 6-32 Screw & Nut		
5 ft.	9C	#22-9 Conductor Cable		
30 ft.	6C	#22-6 Conductor Cable		
5 ft.	RB	#20-Red Battery Cable		
5 ft.	BB	#20-Black Battery Cable		
1	L2	Programs and Instructions		

LAUNCH DIRECTOR CHECK LIST

1 () Turn on Power to computer and monitor

2 () Load LAUNCH program into computer.

3 () Run program.

4 () After Safety Director has connected all test lights and installed the safety key, test each pad (1-5).

5 () Allow SD to disconnect test lights and allow students to connect clips to engines.

6 () Allow communicator to check all operations for GO.

7 () Give GO AHEAD for SD to turn on safety key, and indicate on the computer which launch pad is to be used.

8 () If all systems are GO, continue to step 10. If a system shut down error occurs, allow the SD to make repairs.

9 () If repairs are completed, then type YES to continue the launch sequence.

10 () If the pad checks OK, then enter 10 sec. LAUNCH TIME.

11 () If any personnel should enter the restricted area or an emergency shut down is needed, push FUNCTION KEY (F1).

12 () After a successful launch, check the computer for proper reset.

13 () Allow the Data Terminal Operator and other personnel to complete all flight operations.

14 () After checking with all operating personnel for OK, then continue with the next launch sequence.

15 () After completing all launches and getting the OK from your Instructor, shut down computer and mointor.

SAFETY DIRECTOR CHECK LIST

1 () Check all connectors to see if they are aligned properly.

   1. Interface to computer
   2. Interface to battery
   3. Launch pad to interface

2 () Connect test lights to pads 1-5 and inspect igniter clips.

3 () Insert safety key into interface and allow the Launch Director to check all pads.

4 () If all pads check OK, turn SAFETY KEY OFF, remove key, and test lights.

5 () Allow students to place their rockets on the launch pad and connect igniter clips to the engine.

6 () Check all clips for proper connection.

7 () Insert SAFETY KEY into interface.

8 () Upon direction of Launch Director, turn Safety key to ON position.

9 () Observe launch area to see that no personnel enter restricted area. Should entry occur, turn Safety Key to OFF position immediately and remove key.

10 () If any system shut down occurs, turn SAFETY KEY to OFF, remove key, and proceed to troubleshoot the affected pad.

11 () After all pads have been launched, turn SAFETY KEY to OFF, and remove key. Then allow students to connect the next set of rockets, repeating steps 6 through 11.

12 () After all rockets have been launched, turn SAFETY KEY to OFF, and return it to the instructor.

```
5 REM ******************************************************************
10 REM                          VIC 20 LIGHT ACTIVATED COUNTER PROGRAM
15 REM ******************************************************************
20 GOSUB500
30 PRINT"█THIS PROGRAM USES A ██PHOTOTRANSISTOR ███████INTERFACE TO COUNT
   THE";
40 PRINT"TIMES THE LIGHT ███████INTENSITY IS CHANGED █BY A MOVING OBJECT.
   ██THE ";
50 PRINT"SENSITIVITY LEVEL CAN BE CONTROLLED BY █THE█POTETIOMETER ON ██THE
   INTER FACE.";
60 PRINT"THE ████COUNTER CAN BE RESET █BY HITTING THE ████████FUNCTION █KEY
   F1."
70 PRINT"████████HIT ANY KEY"
80 GETB$:IFB$=""THEN80
100 REM ******** MAIN PROGRAM*********
200 GOSUB500:REM PRINT HEADING
210 POKE37138,254:REM SET BIT 0 FOR INPUT SET 1-7 FOR OUTPUT
220 POKE37136,1:REM SET OUTPUTS LOW
230 B=0:REM CLEARS COUNTER
240 PRINT"██████████████████";B:REM HOME, PRINTS COUNT DOWN 7 ACROSS 8
250 IFPEEK(37136)=0THEN280:REM IF INPUT GOES LOW INCREMENT COUNTER BY 1
260 GETA$:IFA$=CHR$(133)THENGOSUB500:GOTO230:REM RESETS COUNTER BY F1
270 GOTO250:REM CONTINUES COUNT IF F1 IS NOT HIT
280 B=B+1:REM COUNTER
290 IFPEEK(37136)=1THEN240:REM CONTINUES COUNT IF INPUT IS HIGH
300 GOTO290
500 PRINT"♥______________________"
510 PRINT" LIGHT BEAM COUNTER"
520 PRINT"______________________"
530 RETURN
1000 REM ****************************************************************
1005 REM                 JOHN SMART
1010 REM                 3707 WINDMILL LA.
1020 REM                 PLANO, TX 75075
1025 REM ****************************************************************
READY.
```

LIGHT ACTIVATED COUNTER

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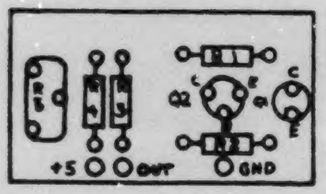
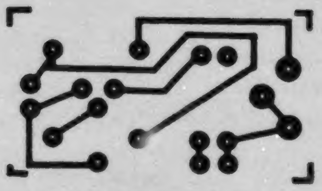
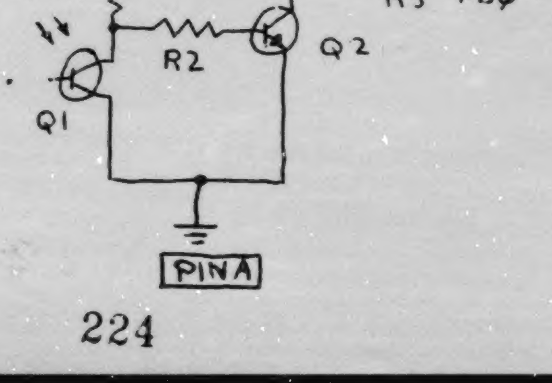

R5
R4
R3
R1
Q2
C
E
Q1
C
E
R2
+5
OUT
GND



Light Activated Counter Parts List

R1= 10k
R2= 4.7K
R3= 2.2K - 1K
R4= 47K
R5= 1Meg pot (RS-271-229)
Q1= Phototransistor (RS-276-130)
Q2= 2N2222


PIN2
+5V
R5
R4
PINC
R1
R3
PBØ
R2
Q2
Q1
PINA

```
1 REM ***************************************************************
2 REM                         64 LIGHT BEAM COUNTER
3 REM ***************************************************************
10 POKE53281,14:PRINT"██████████"TAB(11)"LIGHT BEEM COUNTER"
20 PRINT"█████"TAB(13)"COPYRIGHT 1984 "
30 PRINT"█████"TAB(11)"SMART ELECTRONICS"
40 T=TI
45 IFTI<T+240THEN45
50 GOSUB500
60 PRINT"██THIS PROGRAM USES A PHOTOTRANSISTOR "
61 PRINT"█INTERFACE TO COUNT THE TIMES THE LIGHT"
62 PRINT"█INTENSITY IS CHANGED BY A OBJECT PASSING";
63 PRINT"█BETWEEN THE LIGHT SOURCE AND THE"
64 PRINT"█INTERFACE. THE SENSITIVITY LEVEL CAN BE"
65 PRINT"█ADJUSTED BY THE POTENTIOMETER ON THE"
66 PRINT"█INTERFACE BOARD. THE COUNTER CAN BE"
67 PRINT"█RESET BY HITTING THE FUNCTION KEY F1."
68 PRINT"█"TAB(15)"█HIT ANY HEY█"
70 GETA$:IFA$=""THEN70
75 REM ************ MAIN PROGRAM ************
80 GOSUB500
90 POKE56577,1
100 POKE56579,254
110 B=0
120 PRINT"███████████"TAB(18)B
130 IFPEEK(56577)=0THEN160
140 GETA$:IFA$=CHR$(133)THENGOSUB500:GOTO110
150 GOTO130
160 B=B+1
170 IFPEEK(56577)=1THEN120
180 GOTO170
500 POKE53280,15:
510 PRINT"█________________________________________"
520 PRINTTAB(11)"LIGHT BEAM COUNTER"
530 PRINT"________________________________________"
540 RETURN
600 REM ***************************************************************
610 REM                       JOHN SMART
620 REM                       3707 WINDMILL LA.
630 REM                       PLANO, TX 75075
640 REM ***************************************************************
READY.
```

```
1 REM ****************************************************************
2 REM                           64 TRAFFIC SIGNAL SIMULATOR
3 REM ****************************************************************
10 POKE53280,14:POKE53281,14
20 PRINT"███████████"TAB(8)"TRAFFIC SIGNAL SIMULATOR"
30 PRINT"█████"TAB(13)"COPYRIGHT 1984"
40 PRINT"█████"TAB(11)"SMART ELECTRONICS"
50 T=TI
60 IFTI<T+180THEN60
70 DR=56579:BR=56577:SE=254:RD=253:GE=247:YE=251
75 POKE53280,15
100 GOSUB500
110 POKEBR,RD:POKEDR,SE
120 FORA=1TO200:PRINT"██████████"TAB(5)"RED RESET ";A;:NEXTA:PRINT" READY"
130 IFPEEK(BR)=RDTHEN150
140 GOTO180
150 GETA$:IFA$=CHR$(78)THEN1000
160 IFA$=CHR$(67)THEN2000
170 GOTO130
180 POKEBR,GE
190 B=0
200 B=B+1
210 PRINT"██████████████"TAB(24)"    "
215 PRINT"█"TAB(24)"    "
220 IFB>5THEN280
230 PRINT"████████████"TAB(5)"CYCLE ";B
240 FORC=1TO250:PRINT"███████████████"TAB(5)"GREEN 1ST SEQUENCE";C:NEXTC
250 FORD=1TO125:PRINT"██████████████████"TAB(5)"GREEN 2ND SEQUENCE";D
260 IFPEEK(BR)<>GE THEN200
270 NEXTD
280 POKEBR,YE
290 FORE=1TO100:PRINT"████████████████████"TAB(5)"YELLOW    SEQUENCE";E:NEXTE
300 GOTO100
500 PRINT"█________________________________________"
510 PRINTTAB(8)"TRAFFIC SIGNAL SIMULATOR"
520 PRINT"________________________________________"
530 RETURN
1000 GOSUB500
1010 PRINT"████████████"TAB(5)"FLASHING RED: NIGHT TIME"
1020 POKEBR,RD:FORS=1TO500:NEXTS
1030 PRINT"████████████"TAB(19)"         "
1040 POKEBR,SE:FORT=1TO500:NEXTT
1050 GETA$:IFA$=CHR$(68)THEN100
1060 GOTO1010
2000 GOSUB500
2010 PRINT"████████████"TAB(5)"FLASHING YELLOW: CAUTION"
2020 POKEBR,YE:FORT=1TO500:NEXTT
2030 PRINT"████████████"TAB(22)"            "
2040 POKEBR,SE:FORT=1TO500:NEXTT
2050 GETA$:IFA$=CHR$(68)THEN100
2060 GOTO2010
2070 REM ************************************************************
2080 REM                    JOHN SMART
2090 REM                    3707 WINDMILL LA.
2100 REM                    PLANO, TX 75075
2110 REM ************************************************************
READY.
```

```
10 REM ******************************************************************
20 REM                          VIC 20 TRAFFIC SIGNAL SIMULATOR
30 REM ******************************************************************
90 PRINT"_______________________":REM PRINTS HEADING
100 PRINT"TRAFIC SIGNAL CONTROL"
110 PRINT"______________________
200 POKE37138,254:REM SETS BIT 0 FOR INPUT SETS 1-7 FOR OUTPUT
300 POKE37136,253:REM BIT 1 LOW 2-7 HIGH
400 FORA=1TO200:PRINT"[redacted]RED RESET ";A;:NEXTA:PRINT"READY":REM HOME,
    DOWN5
500 IFPEEK(37136)=253THEN520:REM IF SENSOR IS NOT TRIGGERED THEN RECHECK
    INPUT
510 GOTO600
520 GETA$:IFA$=CHR$(78)THEN2000
530 IFA$=CHR$(67)THEN3000
580 GOTO500
600 POKE37136,247:REM BIT 3 LOW 1-2 AND 4-7 HIGH
700 B=0:REM CYCLE COUNTER
800 B=B+1:REM INCREMENTS COUNTER BY 1
850 PRINT"[redacted]     ":REM CLEARS PREVIOUS COUNT, HOME
    DOWN 9 855 REM ACROSS 15, SPACE 4
875 PRINT"[redacted]     ":REM CLEARS PREVIOUS COUNT,HOME
    DOWN 11
880 REM ACROSS 15, SPACE 4
900 IFB>5THEN1400:REM IF GREEN CYCLE IS >5 THEN GO TO YELLOW CYCLE
950 PRINT"[redacted]CYCLE ";B:REM HOME DOWN 7
1000 FORC=1TO250:PRINT"[redacted]GREEN 1ST SEQ ";C:NEXTC:REM HOME DOWN 9
     GREEN DELAY
1100 FORD=1TO125:PRINT"[redacted]GREEN 2ND SEQ ";D:REM HOME DOWN 11,
     GREEN DELAY
1200 IFPEEK(37136)<>247THEN800:REM WITH BIT 3 LOW CHECK INPUT IF LOW THEN
     RECYCLES GREEN
1300 NEXTD
1400 POKE37136,251:REM BIT 2 LOW 1AND3-7 HIGH
1500 FORE=1TO100:PRINT"[redacted]YELLOW ";E:NEXTE:REM HOME DOWN13 PRINT
     YELLOW COUNT
1600 GOTO90:REM RETURNS TO RED CYCLE
2000 REM FLASHING RED
2001 PRINT"[redacted]FLASHING RED[redacted]"
2002 PRINT"[redacted]NIGHT TIME"
2010 POKE37136,253:FOR S=1TO500:NEXTS
2015 PRINT"[redacted]            "
2016 PRINT"[redacted]          "
2020 POKE37136,255:FORT=1TO500:NEXTT
2030 GETA$: IFA$=CHR$(68)THEN90
2040 GOTO2000
3000 REM CAUTION
3001 PRINT"[redacted]FLASHING CAUTION"
3010 POKE37136,251:FORS=1TO500:NEXTS
3015 PRINT"[redacted]                  "
3020 POKE37136,255:FORT=1TO500:NEXTT
3030 GETA$: IFA$=CHR$(68)THEN90
3040 GOTO3000
3050 REM ******************************************************************
3060 REM                        JOHN SMART
3070 REM                        3707 WINDMILL LA.
3080 REM                        PLANO, TX 75075
3090 REM******************************************************************
READY.
```

```
90 PRINT"♥______________________":REM PRINTS HEADING
100 PRINT"TRAFIC SIGNAL CONTROL"
110 PRINT"______________________
200 POKE36138,254:REM SETS BIT 0 FOR INPUT SETS 1-7 FOR OUTPUT
300 POKE37136,253:REM BIT 1 LOW 2-7 HIGH
400 FORA=1TO200:PRINT"SQQQQQRED RESET ";A;:NEXTA:PRINT"READY":REM HOME, DOWN5
500 IFPEEK(37136)=253THEN500:REM IF SENSOR IS NOT TRIGGERED THEN RECHECK INPUT
600 POKE37136,247:REM BIT 3 LOW 1-2 AND 4-7 HIGH
700 B=0:REM CYCLE COUNTER
800 B=B+1:REM INCREMENTS COUNTER BY 1
850 PRINT"SQQQQQQQQQ]]]]]]]]]]]]]]]    ":REM CLEARS PREVIOUS COUNT, HOME DOWN 9
855 REM ACROSS 15, SPACE 4
875 PRINT"SQQQQQQQQQQQ]]]]]]]]]]]]]]]    ":REM CLEARS PREVIOUS COUNT,HOME DOWN 1
1
880 REM ACROSS 15, SPACE 4
900 IFB>5THEN1400:REM IF GREEN CYCLE IS >5 THEN GO TO YELLOW CYCLE
950 PRINT"SQQQQQQQCYCLE ";B:REM HOME DOWN 7
1000 FORC=1TO250:PRINT"SQQQQQQQQQGREEN 1ST SEQ ";C:NEXTC:REM HOME DOWN 9 GREEN D
ELAY
1100 FORD=1TO125:PRINT"SQQQQQQQQQQQGREEN 2ND SEQ ";D:REM HOME DOWN 11, GREEN DEL
AY
1200 IFPEEK(37136)<>247THEN800:REM WITH BIT 3 LOW CHECK INPUT IF LOW THEN RECYCL
ES GREEN
1300 NEXTD
1400 POKE37136,251:REM BIT 2 LOW 1AND3-7 HIGH
1500 FORE=1TO100:PRINT"SQQQQQQQQQQQQQYELLOW ";E:NEXTE:REM HOME DOWN13 PRINT YELL
OW COUNT
1600 GOTO90:REM RETURNS TO RED CYCLE

READY.
```

```
O H M S'   L A W


ENTER A ZERO (0) FOR EACH UNKNOWN

AMPS? 5
OHMS? 25
VOLTS? 110
WATTS? 0

 5 AMPERS
 25 OHMS
 125 VOLTS
 625 WATTS

ANOTHER CALCULATION ? (1=YES, 2=NO)?
^C
Break in 300
Ready

>LLIST
10 CLS
20 PRINT"                  O H M S'    L A W
30 PRINT
40 REM   BY GORDON SPEER - COMPUTRONICS MAG.
50 PRINT
60 PRINT"ENTER A ZERO (0) FOR EACH UNKNOWN"
70 PRINT
80 INPUT "AMPS";I:INPUT "OHMS";R:INPUT "VOLTS";E:INPUT "WATTS";P
90 FOR T=1 TO 3                 'THREE TIMES THRU THE LIST
100 IF I*R=0 THEN 120'CAN'T SOLVE THE NEXT EQUATION
110 E=I*R                       'OHMS LAW
120 IF E*R=0 THEN 140
130 I=E/R
140 IF E*I=0 THEN 170
150 R=E/I
160 P=I*E                       'POWER FORMULA
170 IF E*P=0 THEN 190
180 I=P/E
190 IF P*I=0 THEN 210
200 E=P/I
210 IF R*P=0 THEN 240
220 LET E=SQR(R*P)
230 LET I=SQR(P/R)
240 NEXT T
250 PRINT
260 PRINT I"AMPERS"
270 PRINT R"OHMS"
280 PRINT E"VOLTS"
290 PRINT P"WATTS"
300 PRINT:INPUT "ANOTHER CALCULATION ? (1=YES, 2=NO)";X
310 IF X=1 THEN 10
320 IF X=2 THEN END
Ready
```

```
RUN
 O R S E P O W E R

PISTON OR JET? PISTON

AIR PRESSURE, P.S.I.            (EX. 14.7)? 14.7

COMPRESSION RATIO               (EX.  8.5)? 7.5

NUMBER OF CYLINDERS             (EX.    8)? 8

BORE IN INCHES          (EX.  4.1)? 3.96

STROKE IN INCHES                (EX.  3.5)? 3.75

REVOLUTIONS PER MIN             (EX. 3500)? 1500

STROKES PER CYCLE               (EX.    4)? 4


            77.1 HORSEPOWER
  ANOTHER CALCULATION ? (1=YES, 2=NO)?

^C
Break in 270
Ready
>LLIST
10 CLS
20 CLEAR 1000
30 PRINT"                   H O R S E P O W E R"
40 PRINT
50 INPUT "PISTON OR JET";E$:PRINT
60 IF E$="JET" THEN 230
70 INPUT "AIR PRESSURE, P.S.I.          (EX. 14.7)";P:PRINT
80 INPUT "COMPRESSION RATIO             (EX.  8.5)";C:PRINT
90 INPUT "NUMBER OF CYLINDERS           (EX.    8)";N:PRINT
100 INPUT "BORE IN INCHES               (EX.  4.1)";B:PRINT
110 LET A=3.14*B/2*B/2          'AREA OF PISTON TOP
120 INPUT "STROKE IN INCHES             (EX.  3.5)";S:PRINT
130 LET S=S/12                  'STROKE IN FEET
140 INPUT "REVOLUTIONS PER MIN          (EX. 3500)";R:PRINT
150 INPUT "STROKES PER CYCLE            (EX.    4)";K:PRINT
160 LET K=K/2                   'REV. PER POWER STROKE
170 PRINT
180 PRINT USING"         #####.# HORSEPOWER";P*C*S*A*N*R/K/33000
190 GOTO 270
200 '****  1 HORSEPOWER = 33000 FOOT POUNDS OF WORK PER MINUTE ****
210 PRINT
220 END
230 INPUT "THRUST IN POUNDS             (EX. 1000)";T:PRINT
240 INPUT "SPEED IN KNOTS               (EX.  650)";S:PRINT
250 PRINT USING"          #####.# HORSEPOWER";T*S/325.
260 PRINT
270 INPUT"  ANOTHER CALCULATION ? (1=YES, 2=NO)";FF
280 IF FF=1 THEN 10
290 IF FF=2 THEN END
Ready
```

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```
 RADIO SHACK  TRS-80 AUTHOR I      Lesson: TEXT1
Version: 01/10/84          Page: 02 of 12   Page type: TEXT

-----------------------------------------------------------------------
'    .      PROGRAM 1. TEMPERATURE CONVERSION                          '
'    .                                                                 '
'    .        This is a short but useful program to quickly            '
'    .     convert from one temperature scale to the other             !
'    .     two major scales.                                           '
'    .                                                                 '
'    .        Load the program and type RUN.  The program              '
'    .     will ask for the temperature that you want con-             !
'    .     converted and then either a K for Kelvin, a C               !
'    .     for Celsius or F for Fahrenheit. This is to indi-           '
'    .     cate the scale your ORIGINAL  temperature was in.           !
'    .     The program will then give you the equivalent               '
'    .     temperatures in teh other scales.                           '
-----------------------------------------------------------------------
```

```
10 ' USE THIS PROGRAM TO CONVERT TEMPERATURE READINGS
15 ' BETWEEN FAHRENHEIT, CELSIUS, AND KELVIN SYSTEMS.
20 '
25 CLS:PRINT@139,"INPUT THE TEMPERATURE AND PRESS ENTER. THEN PRESS F,
   C OR K FOR FAHRENHEIT, CELSIUS OR KELVIN TO INDICATE WHAT SYS
TEM THIS TEMPERATURE WAS IN."
30 INPUT T
35 S$ = INKEY$:IF S$<>"F"ANDS$<>"C"AND S$<>"K" THEN 35
40 '
45 IF S$ = "C" THEN 100
50 IF S$ = "K" THEN 150
55 '
60 '    *** ORIGINAL IN FAHRENHEIT ***
65 F = T
70 C = (F-32)/1.8
75 K = (F+459.67)/1.8
80 GOTO 200                   ' GOTO OUTPUT ROUTINE
85 '
100 '   *** ORIGINAL IN CELSIUS ***
105 C = T
110 F = (1.8*C) + 32
115 K = C + 273.15
120 GOTO 200                  ' GOTO OUTPUT ROUTINE
125 '
150 '   *** ORIGINAL IN KELVIN ***
155 K = T
160 F = (1.8*K) - 459.67
165 C = K - 273.15
170 '
200 ' *** OUTPUT ROUTINE ***
205 CLS:PRINT@139,"THE EQUIVALENT TEMPERATURES ARE..."
210 PRINT:PRINT@267,F;" DEGREES FAHRENHEIT"
215 PRINT@395,C;" DEGREES CELSIUS"
220 PRINT@523,K;" DEGREES KELVIN"
225 END
```

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```
100  REM * PHOTO DILUTIONS *
110  REM *    F. MULLEN     *
120  REM *    TAIU 1984     *

130  TEXT : HOME
140  PRINT  TAB( 8)"PHOTO CHEMICAL DILUTIONS"
150  PRINT : PRINT
160  PRINT "  MANY PHOTOGRAPHIC SOLUTIONS MUST BE"
170  PRINT "DILUTED WITH WATER BEFORE THEY ARE USED."
180  PRINT "  THE CORRECT DILUTION IS USUALLY GIVEN"
190  PRINT "AS A RATIO OF CHEMICAL VOLUME TO WATER"
200  PRINT "VOLUME."
210  PRINT : PRINT : PRINT "  LIKE THIS --> MICRODOL-X (1:3)"
220  PRINT : PRINT : PRINT "  THIS MEANS THAT 1 PART MICRODOL-X"
230  PRINT "DEVELOPER MUST BE DILUTED WITH 3 PARTS"
240  PRINT "WATER BEFORE IT CAN BE USED."
250  PRINT : PRINT "  THIS PROGRAM WILL HELP YOU MIX"
260  PRINT "PHOTOGRAPHIC SOLUTIONS CORRECTLY."
270  PRINT : PRINT : PRINT : INPUT "PRESS RETURN TO CONTINUE: ";A$
280  HOME : CLEAR
290  PRINT  TAB( 8)"PHOTO CHEMICAL DILUTIONS"
300  PRINT : PRINT
310  PRINT " TO FIND THE CORRECT AMOUNT OF WATER"
320  PRINT "AND CHEMICAL NEEDED, ENTER:"
330  PRINT : INPUT "PARTS CHEMICAL ------> ";PC$
340  PC =  VAL (PC$)
350  IF PC <  = 0 THEN 560
360  PRINT : INPUT "PARTS WATER ---------> ";PW$
370  PW =  VAL (PW$)
380  IF PW <  = 0 THEN 560
390  PRINT : INPUT "TOTAL VOLUME (OZ.) --> ";TV$
400  TV =  VAL (TV$)
410  IF TV <  = 0 THEN 560
420  TP = PC + PW
430  P = TV / TP
440  C = PC * P
450  C =  INT (C * 10 + .5) / 10
460  W = PW * P
470  W =  INT (W * 10 + .5) / 10
480  PRINT : PRINT
490  PRINT "VOLUMES NEEDED:"
500  PRINT : PRINT  TAB( 11)"CHEMICAL --> "C" OZ."
510  PRINT : PRINT  TAB( 11)"WATER -----> "W" OZ."
520  PRINT : PRINT : PRINT
530  INPUT "ANOTHER PROBLEM ? (Y/N) ";A$
540  IF  LEFT$ (A$,1) = "N" THEN HOME : END
550  GOTO 280
560  PRINT : PRINT  CHR$ (7)"! TRY AGAIN !": FOR Z = 0 TO 1500
     : NEXT : GOTO 280
```

The second program is "ISOMETRIC". This program will give the starting point for a isometric drawing given width and hieght of the drawing area, and the width, depth, and hieght of the object to be drawn. For example say you want to draw an object that has a width of 4 inches, a depth of 3 inches, and a height of 2 inches. Say you want to draw this object in an area 10 inches by 7 inches. this program will let you pick a scale to draw it in and then either give you the starting point are tell the scale is too large and have you pick another.

Here is a sample run and listing of the program.

```
RUN ISOMETRIC


    THIS IS A PROGRAM TO CENTER A
ISOMETRIC DRAWING OF AN OBJECT IN A
GIVEN DRAWING AREA.


    THIS PROGRAM WILL WORK WITH EITHER
ENGLISH OR METRIC UNITS OF MESUREMENT.


    ENTER THE WIDTH OF YOUR DRAWING
AREA?10
    ENTER THE HIEGHT OF YOUR DRAWING
AREA?7


DIMENSIONS OF THE OBJECT TO BE DRAWN.
    ENTER THE WIDTH    ?4
    ENTER THE DEPTH    ?3
    ENTER THE HIEGHT   ?2


    ENTER THE SCALE FACTOR, i. e.
1 = FULL SIZE; 2 = DOUBLE SIZE;
.5 = HALF SIZE; .25 = 1/4th SIZE;
?7


    THE DRAWING IS TO LARGE FOR THE
AREA. PLEASE PICK A DIFFERENT SCALE.


    ENTER THE SCALE FACTOR, i. e.
1 = FULL SIZE; 2 = DOUBLE SIZE;
.5 = HALF SIZE; .25 = 1/4th SIZE;
?1
```

```
     THE STARTING POINT SHOULD BE 5.43
UNITS FROM THE LEFT EDGE OF THE AREA,
AND .75 UNITS FROM THE BOTTOM EDGE
OF THE AREA.
```

```
DO YOU WANT TO RE-RUN THE PROGRAM (Y/N)?
]LIST

10  REM THIS PROGRAM WILL
20  REM HELP YOU CENTER AN
30  REM ISOMETRIC DRAWING.
40  HOME : PRINT : PRINT : PRINT

50  PRINT  TAB( 5)"THIS IS A PROG
     RAM TO CENTER A"
60  PRINT "ISOMETRIC DRAWING OF A
     N OBJECT IN A"
70  PRINT "GIVEN DRAWING AREA."
80  PRINT : PRINT : PRINT
82  PRINT  TAB( 5)"THIS PROGRAM W
     ILL WORK WITH EITHER"
84  PRINT "ENGLISH OR METRIC UNIT
     S OF MESUREMENT."
85  PRINT : PRINT : PRINT
90  PRINT  TAB( 5)"ENTER THE WIDT
     H OF YOUR DRAWING"
95  PRINT "AREA";: INPUT W
100  PRINT  TAB( 5)"ENTER THE HIE
     GHT OF YOUR DRAWING"
105  PRINT "AREA";: INPUT H
110  PRINT : PRINT : PRINT
115  PRINT "DIMENSIONS OF THE OBJ
     ECT TO BE DRAWN."
120  PRINT  TAB( 5)"ENTER THE WID
     TH   ";: INPUT W2
140  PRINT  TAB( 5)"ENTER THE DEP
     TH   ";: INPUT D1
150  PRINT  TAB( 5)"ENTER THE HIE
     GHT  ";: INPUT H2
151  REM
152  REM ENTER SCALE
153  REM
154  PRINT : PRINT : PRINT
155  PRINT  TAB( 5)"ENTER THE SCA
     LE FACTOR, i. e."
156  PRINT "1 = FULL SIZE; 2 = DO
     UBLE SIZE; "
```

```
157  PRINT ".5 = HALF SIZE; .25 =
      1/4th SIZE;"
158  INPUT SC: PRINT : PRINT : PRINT
     : PRINT
159 WO = W2 * SC:D = D1 * SC:H1 =
     H2 * SC
160  REM
170  REM COMPUTE THE CENTER.
180  REM
190 X = WO * .5
200 Y = D * .5
210 Z = X + Y + H1
220 PC =  COS (30 * 3.1416 / 180)

230 X1 = WO * PC
340 Y1 = D * PC
350 Z1 = X1 + Y1
360 I = (W - Z1) / 2 + X1
370 J = (H - Z) / 2
374 I =  INT (I * 100 + .5) / 100

375 J =  INT (J * 100 + .5) / 100

380  HOME : PRINT : PRINT : PRINT
     : PRINT : PRINT : PRINT
385  IF Z1 > W OR J < 0 GOTO 440
390  PRINT  TAB( 5)"THE STARTING
     POINT SHOULD BE ";I
400  PRINT "UNITS FROM THE LEFT E
     DGE OF THE AREA,"
410  PRINT "AND ";J;" UNITS FROM
     THE BOTTOM EDGE"
415  PRINT "OF THE AREA."
420  PRINT : PRINT : PRINT : PRINT
     : PRINT
430  GOTO 600
440  FOR S = 1 TO 200:A = S * 1: NEXT
     S
442  INVERSE
445  PRINT  TAB( 5)"THE DRAWING I
     S TO LARGE FOR THE"
450  PRINT "AREA. PLEASE PICK A D
     IFFERENT SCALE."
455  NORMAL
460  GOTO 154
600  PRINT : PRINT : PRINT
610  PRINT "DO YOU WANT TO RE-RUN
      THE PROGRAM (Y/N)?";: GET X
     $
620  IF X$ = "N" GOTO 700
630  IF X$ = "Y" GOTO 85
640  GOTO 600
700  HOME
710  END

]
```

GRAPHICS

This set of programs deals with Three-Dimensional Graphics. The first program of the group is "DEFINE OBJECT". This program defines an object in 3-D to be viewed by another program, called "VIEWS". The objects created by "DEFINE OBJECT" can be viewed by the program "VIEW OBJECT", but "VIEW OBJECT" does not remove hidden lines, nor does it center the object, or allow for parallel projections.

"DEFINE OBJECT" works on the basis of a three coordinant system. They are the X, Y, and Z-coordinants. To use this program you must have the object defined in this type of coordinant system.

To run this program you need to know the number of sides the object has, the number of corners it has, the coordinants of each corner, and what corners are in what sides. You must also be able to enter the corners that make up the sides in counterclockwise order as they appear while viewing the side from outside the object.

IMPORTANT NOTE FOR ALL GRAPHICS PROGRAMS: Somtimes when you turn on the graphics page it will delete part of your basic program. To avoid this run the program "ALLOCATE" which moves your basic program to a different location in memory, thus getting it out of the way of the graphics page. This will only be necessary for long graphics programs.

After "DEFINE OBJECT" has run it will ask you if you want to view the object. If you enter Y then "DEFINE OBJECT" will run the program "VIEW OBJECT".

Here then is a sample run and listing of "DEFINE OBJECT".

```
RUN   DEFINE OBJECT


    THIS PROGRAM LETS YOU DEFINE AN
OBJECT IN 3-D.
         DEMONSTRATION PROGRAM
        FOR EDUCATIONAL USE ONLY



    PRESS <RETURN> TO CONTINUE?



    TO RUN THIS PROGRAM YOU MUST KNOW
THE NUMBER OF SIDES AND THE NUMBER
OF CORNERS. YOU MUST ALSO BE ABLE TO
SAY WHICH CORNERS COMPRISE WHICH
SIDES.

    YOU WILL NEED TO BE ABLE TO GIVE
THE CORNERS IN COUNTERCLOCKWISE ORDER
AS THEY APPEAR WHEN OBSERVED FROM
FROM OUTSIDE THE OBJECT.


    DO YOU HAVE THIS INFORMATION (Y/N)?


ENTER THE NUMBER OF SIDES?6
ENTER THE NUMBER OF CORNERS?8



ENTER THE X-COORDINANT OF CORNER 1 ?0
ENTER THE Y-COORDINANT OF CORNER 1 ?0
ENTER THE Z-COORDINANT OF CORNER 1 ?0

ENTER THE X-COORDINANT OF CORNER 2 ?4
ENTER THE Y-COORDINANT OF CORNER 2 ?0
ENTER THE Z-COORDINANT OF CORNER 2 ?0

ENTER THE X-COORDINANT OF CORNER 3 ?4
ENTER THE Y-COORDINANT OF CORNER 3 ?4
ENTER THE Z-COORDINANT OF CORNER 3 ?0

ENTER THE X-COORDINANT OF CORNER 4 ?0
ENTER THE Y-COORDINANT OF CORNER 4 ?4
ENTER THE Z-COORDINANT OF CORNER 4 ?0

ENTER THE X-COORDINANT OF CORNER 5 ?0
ENTER THE Y-COORDINANT OF CORNER 5 ?0
ENTER THE Z-COORDINANT OF CORNER 5 ?-4

ENTER THE X-COORDINANT OF CORNER 6 ?4
ENTER THE Y-COORDINANT OF CORNER 6 ?0
ENTER THE Z-COORDINANT OF CORNER 6 ?-4

ENTER THE X-COORDINANT OF CORNER 7 ?4
ENTER THE Y-COORDINANT OF CORNER 7 ?4
ENTER THE Z-COORDINANT OF CORNER 7 ?-4

ENTER THE X-COORDINANT OF CORNER 8 ?0
ENTER THE Y-COORDINANT OF CORNER 8 ?4
ENTER THE Z-COORDINANT OF CORNER 8 ?-4


HOW MANY CORNERS ARE IN SIDE 1 ?4


ENTER THE CORNERS OF SIDE 1.
BE SURE TO ENTER THE CORNERS IN
COUNTERCLOCKWISE ORDER, AS THEY APPEAR
WHILE VIEWING THE OBJECT FROM THE
OUTSIDE.

ENTER THE NUMBER OF CORNER 1 OF
SIDE 1 ?1
ENTER THE NUMBER OF CORNER 2 OF
SIDE 1 ?2
ENTER THE NUMBER OF CORNER 3 OF
SIDE 1 ?3
ENTER THE NUMBER OF CORNER 4 OF
SIDE 1 ?4

HOW MANY CORNERS ARE IN SIDE 2 ?4


ENTER THE CORNERS OF SIDE 2.
BE SURE TO ENTER THE CORNERS IN
COUNTERCLOCKWISE ORDER, AS THEY APPEAR
WHILE VIEWING THE OBJECT FROM THE
OUTSIDE.

ENTER THE NUMBER OF CORNER 1 OF
SIDE 2 ?8
ENTER THE NUMBER OF CORNER 2 OF
SIDE 2 ?7
ENTER THE NUMBER OF CORNER 3 OF
```

```
SIDE 2 ?6
ENTER THE NUMBER OF CORNER 4 OF
SIDE 2 ?5


HOW MANY CORNERS ARE IN SIDE 3 ?4



ENTER THE CORNERS OF SIDE 3.
BE SURE TO ENTER THE CORNERS IN
COUNTERCLOCKWISE ORDER, AS THEY APPEAR
WHILE VIEWING THE OBJECT FROM THE
OUTSIDE.


ENTER THE NUMBER OF CORNER 1 OF
SIDE 3 ?2
ENTER THE NUMBER OF CORNER 2 OF
SIDE 3 ?6
ENTER THE NUMBER OF CORNER 3 OF
SIDE 3 ?7
ENTER THE NUMBER OF CORNER 4 OF
SIDE 3 ?3


HOW MANY CORNERS ARE IN SIDE 4 ?4



ENTER THE CORNERS OF SIDE 4.
BE SURE TO ENTER THE CORNERS IN
COUNTERCLOCKWISE ORDER, AS THEY APPEAR
WHILE VIEWING THE OBJECT FROM THE
OUTSIDE.


ENTER THE NUMBER OF CORNER 1 OF
SIDE 4 ?5
ENTER THE NUMBER OF CORNER 2 OF
SIDE 4 ?1
ENTER THE NUMBER OF CORNER 3 OF
SIDE 4 ?4
ENTER THE NUMBER OF CORNER 4 OF
SIDE 4 ?8


HOW MANY CORNERS ARE IN SIDE 5 ?4



ENTER THE CORNERS OF SIDE 5.
BE SURE TO ENTER THE CORNERS IN
```

```
COUNTERCLOCKWISE ORDER, AS THEY APPEAR
WHILE VIEWING THE OBJECT FROM THE
OUTSIDE.


ENTER THE NUMBER OF CORNER 1 OF
SIDE 5 ?4
ENTER THE NUMBER OF CORNER 2 OF
SIDE 5 ?3
ENTER THE NUMBER OF CORNER 3 OF
SIDE 5 ?7
ENTER THE NUMBER OF CORNER 4 OF
SIDE 5 ?8


HOW MANY CORNERS ARE IN SIDE 6 ?4



ENTER THE CORNERS OF SIDE 6.
BE SURE TO ENTER THE CORNERS IN
COUNTERCLOCKWISE ORDER, AS THEY APPEAR
WHILE VIEWING THE OBJECT FROM THE
OUTSIDE.


ENTER THE NUMBER OF CORNER 1 OF
SIDE 6 ?5
ENTER THE NUMBER OF CORNER 2 OF
SIDE 6 ?6
ENTER THE NUMBER OF CORNER 3 OF
SIDE 6 ?2
ENTER THE NUMBER OF CORNER 4 OF
SIDE 6 ?1


WHAT FILE DO YOU WANT THE OBJECT
SAVED IN?CUBE



THIS PROGRAM WILL ALSO ALLOW YOU TO
VIEW THE OBJECT. DO YOU WANT TO VIEW
THE OBJECT (Y/N)?


]LIST

2  REM THIS IS A PROGRAM TO
4  REM DEFINE AN OBJECT IN
6  REM THREE DIMENSIONS.
8  REM
```

```
10  REM THIS PROGRAM WILL
12  REM HAVE THE USER
14  REM ENTER THE NUMBER OF
16  REM SIDES AND THEN
18  REM ENTER THE NUMBER
20  REM OF CORNERS. THEN
22  REM THE PROGRAM HAS THE
24  REM USER SPECIFY WHERE
26  REM THE CONERS ARE.
28  REM THE PROGRAM THEN
30  REM ASK WHAT CORNERS
32  REM ARE IN WHAT
34  REM SIDES. THE
36  REM PROGRAM STORES
38  REM SIDES AS EDGES
40  REM AND THE EDGES
42  REM ARE SAVED AS
44  REM CORNERS.
46  REM
48  REM THE DATA CREATED
50  REM BY THIS PROGRAM
52  REM IS STORED IN A FILE
54  REM TO BE VIEWED BY
56  REM THE PROGRAM "VIEWS".
58  REM
60  REM THIS PROGRAM ALSO ALLOWS
62  REM THE USER TO VIEW THE
64  REM OBJECT, BUT WITHOUT
66  REM THE HIDDEN-LINES
68  REM REMOVED.
70  REM
75  DIM V(40,3),E(40,2),S(10,10)
78  REM
79  HOME : PRINT : PRINT : PRINT

80  PRINT  TAB( 5)"THIS PROGRAM L
     ETS YOU DEFINE AN"
90  PRINT "OBJECT IN 3-D."
91  VTAB 10
92  INVERSE
93  HTAB 10: PRINT "DEMONSTRATION
      PROGRAM"
94  HTAB 9: PRINT "FOR EDUCATIONA
     L USE ONLY"
95  NORMAL
96  PRINT : PRINT : PRINT
97  PRINT  TAB( 5)"PRESS <RETURN>
      TO CONTINUE";: INPUT A$
98  HOME : PRINT : PRINT : PRINT

100  PRINT  TAB( 5)"TO RUN THIS P
     ROGRAM YOU MUST KNOW"
110  PRINT "THE NUMBER OF SIDES A
```

```
      ND THE NUMBER"
 120  PRINT "OF CORNERS. YOU MUST
      ALSO BE ABLE TO"
 130  PRINT "SAY WHICH CORNERS COM
      PRISE WHICH"
 140  PRINT "SIDES."
 150  PRINT
 160  PRINT  TAB( 5)"YOU WILL NEED
       TO BE ABLE TO GIVE"
 170  PRINT "THE CORNERS IN COUNTE
      RCLOCKWISE ORDER"
 180  PRINT "AS THEY APPEAR WHEN O
      BSERVED FROM"
 190  PRINT "FROM OUTSIDE THE OBJE
      CT.": PRINT : PRINT
 200  PRINT  TAB( 5)"DO YOU HAVE T
      HIS INFORMATION (Y/N)?";
 205  GET A$: PRINT : PRINT : PRINT

 210  IF A$ = "N" GOTO 620
 220  IF A$ = "Y" GOTO 240
 230  PRINT  TAB( 5)"ILLEGAL ENTRY
      , TRY AGAIN.": PRINT : PRINT
      : PRINT : GOTO 200
 240  PRINT "ENTER THE NUMBER OF S
      IDES";
 250  INPUT NS
 260  PRINT "ENTER THE NUMBER OF C
      ORNERS";
 270  INPUT NV
 275  PRINT : PRINT : PRINT
 280  FOR I = 1 TO NV
 290  PRINT "ENTER THE X-COORDINAN
      T OF CORNER ";I;" ";
 300  INPUT V(I,1)
 310  PRINT "ENTER THE Y-COORDINAN
      T OF CORNER ";I;" ";
 320  INPUT V(I,2)
 330  PRINT "ENTER THE Z-COORDINAN
      T OF CORNER ";I;" ";
 340  INPUT V(I,3)
 345  PRINT
 350  NEXT I
 355 K = 0
 360  FOR I = 1 TO NS
 370  PRINT : PRINT : PRINT "HOW M
      ANY CORNERS ARE IN SIDE ";I;
      " ";
 380  INPUT SV
 385  PRINT : PRINT : PRINT
 390  PRINT "ENTER THE CORNERS OF
      SIDE ";I;"."
 400  PRINT "BE SURE TO ENTER THE
```

```
     CORNERS IN"
410  PRINT "COUNTERCLOCKWISE ORDE
     R, AS THEY APPEAR"
420  PRINT "WHILE VIEWING THE OBJ
     ECT FROM THE"
430  PRINT "OUTSIDE.": PRINT : PRINT

440  FOR J = 1 TO SV
450  PRINT "ENTER THE NUMBER OF C
     ORNER ";J;" OF"
460  PRINT "SIDE ";I;" ";: INPUT
     Q
470 E(K + J,1) = Q
475 S(I,J) = K + J
480  IF J = 1 GOTO 500
490 E(K + J - 1,2) = Q
500  IF J <  > SV GOTO 520
510 E(K + J,2) = E(K + 1,1)
520  NEXT J
530 K = K + SV
535  NEXT I
536 D$ =  CHR$ (4)
541  PRINT : PRINT : PRINT "WHAT
     FILE DO YOU WANT THE OBJECT"
     : PRINT "SAVED IN";: INPUT N
     $: PRINT : PRINT : PRINT
542  PRINT D$;"OPEN";N$: PRINT D$
     ;"CLOSE";N$
543  PRINT D$;"DELETE";N$
544  PRINT D$;"OPEN";N$
545  PRINT D$;"WRITE";N$
546  FOR I = 1 TO 40: PRINT V(I,1
     ): PRINT V(I,2): PRINT V(I,3
     ): NEXT I
547  FOR I = 1 TO 40: PRINT E(I,1
     ): PRINT E(I,2): NEXT I
548  FOR I = 1 TO 10: FOR J = 1 TO
     10: PRINT S(I,J): NEXT J: NEXT
     I
549  PRINT D$;"CLOSE";N$
550  PRINT "THIS PROGRAM WILL ALS
     O ALLOW YOU TO"
555  PRINT "VIEW THE OBJECT. DO Y
     OU WANT TO VIEW"
560  PRINT "THE OBJECT (Y/N)?";
570  GET A$: PRINT : PRINT : PRINT

580  IF A$ = "N" GOTO 620
590  IF A$ = "Y" GOTO 610
600  PRINT "ILLEGAL ENTRY, TRY AG
     AIN.": PRINT : PRINT : PRINT

610  PRINT D$;"RUN VIEW OBJECT"

620  END

]
```

The second program in the graphics group is "VIEW OBJECT". This program allows you to view any object defined by "DEFINE OBJECT". using this program you can view the object from any angle and at any distance, but all projections will be prespective, and all lines will be visible. "VIEW OBJECT" can be run independently or by the program "DEFINE OBJECT".

This program contains a subroutine called "Clip". Clip finds all the lines that would cause the program to try to plot off the screen and clips them to the screen's edge. If the line is entirely off the screen clip tells the program to skip plotting the line altogether. This is important because if the program should try to plot off the screen it would give an error message and stop running.

Here is a sample run and listing of the program.

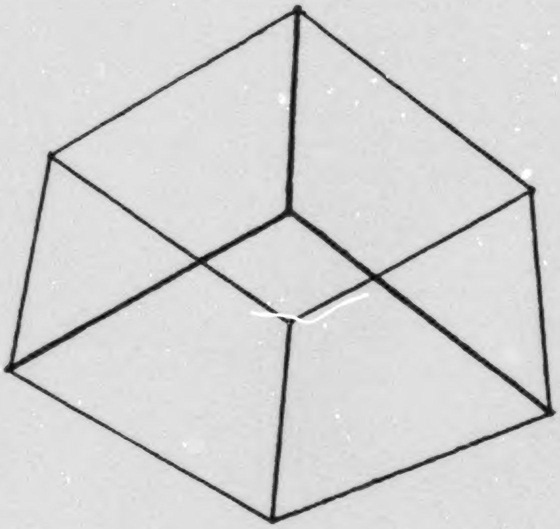
```
]RUN VIEW OBJECT
WHAT FILE DID YOU PUT THE OBJECT IN?CUBE



WHAT SIZE WINDOW DO YOU WANT?
PICK A SIZE LARGER THAN THE OBJECTS
LARGEST MEASUREMENT?20



WHAT ANGLE OFF THE X-AXIS DO YOU WANT
VIEW THE OBJECT FROM?45
WHAT ANGLE OFF THE Z-AXIS DO YOU WANT
TO VIEW THE OBJECT FROM ?135
PRESS ANY KEY TO CONTINUE?
```



```
DO YOU WISH TO:
        C. CHANGE VIEW
        E. EXIT PROGRAM



]LIST

540  DIM V(40,3),E(40,2),S(10,10)

541  PRINT "WHAT FILE DID YOU PUT
      THE OBJECT IN";: INPUT N$
542 D$ =  CHR$ (4)
543  HCOLOR= 3
544  PRINT D$;"OPEN";N$
545  PRINT D$;"READ ";N$
546  FOR I = 1 TO 40: INPUT V(I,1
     ): INPUT V(I,2): INPUT V(I,3
     ): NEXT I
547  FOR I = 1 TO 40: INPUT E(I,1
     ): INPUT E(I,2): NEXT I
548  FOR I = 1 TO 10: FOR J = 1 TO
     10: INPUT S(I,J): NEXT J: NEXT
     I
549  PRINT D$;"CLOSE";N$
570  PRINT : PRINT : PRINT
620 D = 279:R = 279:L = 0:T = 0:B
     = 191:SC = 280 / 192
625  PRINT "WHAT SIZE WINDOW DO Y
     OU WANT?"
630  PRINT "PICK A SIZE LARGER TH
     AN THE OBJECTS"
640  PRINT "LARGEST MEASUREMENT";

650  INPUT RH
660  PRINT : PRINT : PRINT
670  PRINT "WHAT ANGLE OFF THE X-
     AXIS DO YOU WANT"
680  PRINT "VIEW THE OBJECT FROM"
     ;: INPUT TH
682  IF TH < 360 GOTO 690
684 TH = TH - 360
686  GOTO 682
690 TH = TH * 3.141592654 / 180
700  PRINT "WHAT ANGLE OFF THE Z-
     AXIS DO YOU WANT"
710  PRINT "TO VIEW THE OBJECT FR
     OM ";: INPUT PH
712  IF PH < 360 GOTO 720
714 PH = PH - 360
716  GOTO 712
720 PH = PH * 3.141592654 / 180
```

```
725  HGR
730 S1 =  SIN (TH)
740 S2 =  SIN (PH)
750 C1 =  COS (TH)
760 C2 =  COS (PH)
770 I = 1
780  IF E(I,1) = 0 GOTO 990
785 RE = 0
790 X = V(E(I,1),1)
800 Y = V(E(I,1),2)
810 Z = V(E(I,1),3)
820 X1 =  - X * S1 + Y * C1
830 Y1 =  - X * C1 * C2 - Y * S1 *
     C2 + Z * S2
840 Z1 =  - X * S2 * C1 - Y * S2 *
     S1 - Z * C2 + RH
850 XF = D * (X1 / Z1) * SC + 140

860 YF = 96 - D * (Y1 / Z1)
870 X = V(E(I,2),1)
880 Y = V(E(I,2),2)
890 Z = V(E(I,2),3)
900 X2 =  - X * S1 + Y * C1
910 Y2 =  - X * C1 * C2 - Y * S1 *
     C2 + Z * S2
920 Z2 =  - X * S2 * C1 - Y * S2 *
     S1 - Z * C2 + RH
930 XT = D * (X2 / Z2) * SC + 140

940 YT = 96 - D * (Y2 / Z2)
950  GOSUB 1100
955  IF RE = 1 GOTO 970
960  HPLOT XF,YF TO XT,YT
970 I = I + 1
980  GOTO 780
990  PRINT "PRESS ANY KEY TO CONT
     INUE?": GET A$
1000  TEXT
1010  PRINT "DO YOU WISH TO:"
1020  PRINT  TAB( 10)"C. CHANGE V
     IEW"
1030  PRINT  TAB( 10)"E. EXIT PRO
     GRAM"
1040  GET A$: PRINT : PRINT : PRINT

1050  IF A$ = "C" GOTO 625
1060  IF A$ = "E" GOTO 1090
1070  PRINT "ILLEGAL ENTRY, TRY A
     GAIN.": PRINT : PRINT : PRINT

1080  GOTO 1010
1090  END
1092  REM  THIS IS A
```

```
1093  REM ROUTINE TO CLIP
1094  REM LINES BEING
1095  REM DRAWN TO THE
1096  REM SCREEN.
1097  REM
1100 L1 = 0:R1 = 0:T1 = 0:B1 = 0:
     L2 = 0:R2 = 0:T2 = 0:B2 = 0
1101  REM VARIABLES: L-LEFT
1102  REM R-RIGHT, T-TOP,
1103  REM B-BOTTOM. VARIA-
1104  REM BLES LIKE L1 CLIP
1105  REM THE FIRST POINT
1106  REM AND LIKE L2 CLIP
1107  REM THE SECOND.
1108  REM
1109  REM CLIP 1ST TO LEFT
1110  IF XF >  = L GOTO 1130
1120 L1 = 1
1124  REM
1125  REM CLIP 1ST TO RIGHT
1126  REM
1130  IF XF <  = R THEN 1150
1140 R1 = 1
1144  REM
1145  REM CLIP 1ST TO TOP
1146  REM
1150  IF YF >  = T THEN 1170
1160 T1 = 1
1164  REM
1165  REM CLIP 1ST TO BOTTOM
1166  REM
1170  IF YF <  = B THEN 1190
1180 B1 = 1
1188  REM
1189  REM CLIP 2ND TO LEFT
1190  IF XT >  = L THEN 1210
1200 L2 = 1
1208  REM
1209  REM CLIP 2ND TO RIGHT
1210  IF XT <  = R THEN 1230
1220 R2 = 1
1228  REM
1229  REM CLIP 2ND TO TOP
1230  IF YT >  = T THEN 1250
1240 T2 = 1
1248  REM
1249  REM CLIP 2ND TO BOTTOM
1250  IF YT <  = B THEN 1270
1260 B2 = 1
1261  REM
1262  REM ACCEPT LINE IF
1263  REM BOTH POINTS ARE
1264  REM WITHIN THE
```

```
1265  REM BOUNDERY.
1266  REM
1270  IF L1 <   > 0 OR L2 <   > 0 OR
     R1 <   > 0 OR R2 <   > 0 GOTO
     1290
1280  IF T1 = 0 AND T2 = 0 AND B1
      = 0 AND B2 = 0 THEN  RETURN

1281  REM
1282  REM IF RE=1 REJECT LINE
1290  IF L1 <   > 0 AND L2 <   > 0 THEN
     RE = 1
1291  IF R1 <   > 0 AND R2 <   > 0 THEN
     RE = 1
1293  IF T1 <   > 0 AND T2 <   > 0 THEN
     RE = 1
1294  IF B1 <   > 0 AND B2 <   > 0 THEN
     RE = 1
1300  IF RE = 1 THEN  RETURN
1301  REM
1302  REM THIS SECTION FINDS
1303  REM THE INTERSECTION OF
1304  REM THE LINE AND ONE OF
1305  REM BOUNDS, THEN SENDS
1306  REM THE LINE BACK
1307  REM THROUGH THE
1308  REM SUBROUTINE.
1309  REM  INTER. 1ST TO LEFT
1310  IF L1 <   > 1 GOTO 1350
1320 YF = YF + (YT - YF) * (L - X
     F) / (XT - XF)
1330 XF = L
1340  GOTO 1100
1344  REM
1345  REM INTER. 1ST WITH RIGHT
1346  REM
1350  IF R1 <   > 1 GOTO 1390
1360 YF = YF + (YT - YF) * (R - Y
     F) / (XT - XF)
1370 XF = R
1380  GOTO 1100
1384  REM
1385  REM 1ST WITH TOP
1386  REM
1390  IF T1 <   > 1 GOTO 1430
1400 XF = XF + (XT - XF) * (T - Y
     F) / (YT - YF)
1410 YF = T
1420  GOTO 1100
1424  REM
1425  REM 1ST WITH BOTTOM
1426  REM
1430  IF B1 <   > 1 GOTO 1470
```

```
1440 XF = XF + (XT - XF) * (B - Y
     F) / (YT - YF)
1450 YF = B
1460  GOTO 1100
1464  REM
1465  REM 2ND WITH LEFT
1466  REM
1470  IF L2 <  > 1 GOTO 1510
1480 YT = YF + (YT - YF) * (L - X
     F) / (XT - XF)
1490 XT = L
1500  GOTO 1100
1504  REM
1505  REM 2ND WITH RIGHT
1506  REM
1510  IF R2 <  > 1 GOTO 1550
1520 YT = YF + (YT - YF) * (R - X
     F) / (XT - XF)
1530 XT = R
1540  GOTO 1100
1544  REM
1545  REM 2ND WITH TOP
1546  REM
1550  IF T2 <  > 1 GOTO 1590
1560 XT = XF + (XT - XF) * (T - Y
     F) / (YT - YF)
1570 YT = T
1580  GOTO 1100
1584  REM
1585  REM 2ND WITH BOTTOM
1586  REM
1590  IF B2 <  > 1 GOTO 1100
1600 XT = XF + (XT - XF) * (B - Y
     F) / (YT - YF)
1610 YT = B
1620  GOTO 1100
1883  REM REJECT IF BOTH
1884  REM POINTS ARE OUTSIDE
1885  REM OF BOUNDERY.
1886  REM

]
```

The next program is "VIEWS". This program will allow you to view any object defined by "DEFINE OBJECT". It will allow you to use parallel projections, like front, top, and right side views. Or, you can use prespective projections. You can view the object from any angle and any distance. This program will allow you to move around to object any number of degrees and stoping along the way any number of times. Doing this is refered to as rotating about the object. This program will remove hidden lines. "VIEWS" also contains the subroutine Clip, as described in the section on "VIEW OBJECT". This progrm does not, however, run fast enough to do animation.

For example say you wanted to do a top, front, and right side projection of the object. For projection type you would use parallel. For scale you would use something large enough to make the object easily studied. For the top view set the angle off the x-axis at 90 and the off the z-axis at zero. Then for a front view rotate the x-axis 0 degrees and the z-axis 90 degrees. Finally for a right side view rotate x 90 degrees and z 0 degrees. Thus you have the three views.

Before running this program you must run allocate to allow for enough space. Here is a sample run and listing of the program.

The next program is "ALLOCATE". This program will move the starting address of any program in memory and the line counter to a new location. It will stay in effect until the machine is rebooted. This program should be run when a basic program is so large that the graphics page, or anything, causes it to bomb or be partially deleted. This program casues no echo to the screen so there is no sample run of it.

Here is a listing of the program.

```
LOAD ALLOCATE
]LIST

10  REM SOME OF THE GRAPHIC
20  REM PROGRAMS USE A LARGE
30  REM AMOUNT OF MEMORY, SO
40  REM IT MAY BE NECESSARY
50  REM TO RUN THIS PROGRAM
60  REM WHICH MOVES THE
70  REM PROGAM TO DIFFERENT
80  REM LOCATION IN MEMORY,
90  REM FOR THE GRAPHICS TO
100  REM WORK PROPERLY.
110  REM
120  REM THIS PROGRAM WILL
130  REM MOVE THE BASIC
140  REM PROGRAM THUS ALLOWING
150  REM THE SYSTEMS GRAPHICS
160  REM MORE SPACE.
170  REM
200  POKE 103,1
210  POKE 104,96
220  POKE 24576,0
230  END

]
```

```
]RUN ALLOCATE

]RUN VIEWS


     THIS IS A PROGRAM TO VIEW AN
OBJECT FROM SEVERAL DIFFERENT ANGLES.
          DEMONSTRATION PROGRAM
         FOR EDUCATIONAL USE ONLY



     PRESS <RETURN> TO CONTINUE?



     WHAT FILE IS THE OBJECT IN?HOUSE



     THIS PROGRAM WILL ALLOW YOU TO
USE TWO TYPES OF PROJECTIONS,
PARALLEL AND PRESPECTIVE.
     WHICH WOULD YOU PREFER:
          A. PARALLEL
          B. PRESPECTIVE



     WHAT SCALE FACTOR DO YOU WANT?40





     HOW MANY DEGREES OFF THE X AXIS DO
YOU WANT THE STARTING VIEWPOINT?90
HOW MANY DEGREES OFF THE Z-AXIS?0
WAIT`FOR`IMAGE
STILL`PROCESSING
ONE`MOMENT`PLEASE
THERE IS ABSOLUTLY NO CAUSE FOR CONCERN
PRESS ANY KEY TO CONTINUE?



    DO YOU WANT TO
         R. ROTATE THE OBJECT
         A. ALTER PROJECTION TYPE
         E. EXIT PROGRAM
     HOW MANY DEGREES ALONG THE
X-AXIS DO YOU WANT IT ROTATED?0
HOW MANY DEGREES ALONG THE Z-AXIS?90
HOW MANY STEPS DO YOU WANT?1
WAIT`FOR`IMAGE
STILL`PROCESSING
ONE`MOMENT`PLEASE
THERE IS ABSOLUTLY NO CAUSE FOR CONCERN
PRESS ANY KEY TO CONTINUE?


     DO YOU WANT TO
            R. ROTATE THE OBJECT
            A. ALTER PROJECTION TYPE
            E. EXIT PROGRAM


     HOW MANY DEGREES ALONG THE
X-AXIS DO YOU WANT IT ROTATED?90
HOW MANY DEGREES ALONG THE Z-AXIS?0
HOW MANY STEPS DO YOU WANT?1
WAIT`FOR`IMAGE
STILL`PROCESSING
ONE`MOMENT`PLEASE
THERE IS ABSOLUTLY NO CAUSE FOR CONCERN
PRESS ANY KEY TO CONTINUE?

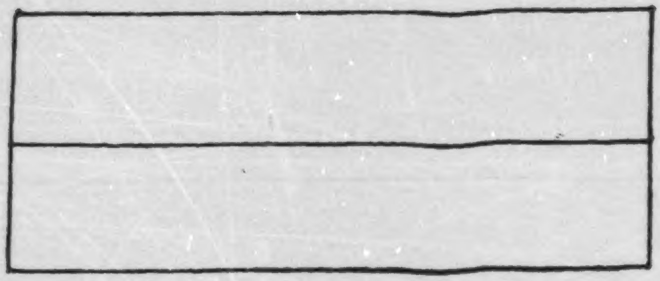

     DO YOU WANT TO
            R. ROTATE THE OBJECT
            A. ALTER PROJECTION TYPE
            E. EXIT PROGRAM

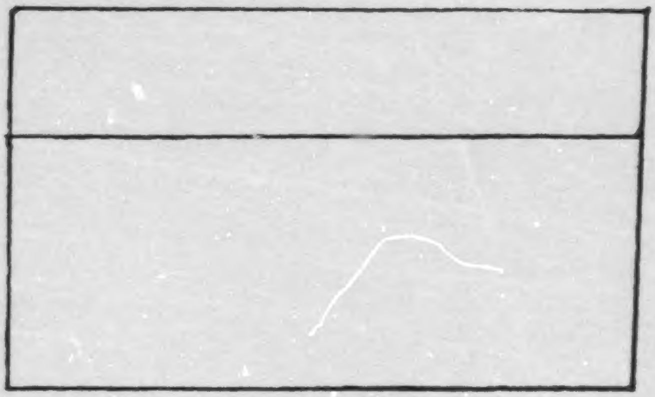
]LIST

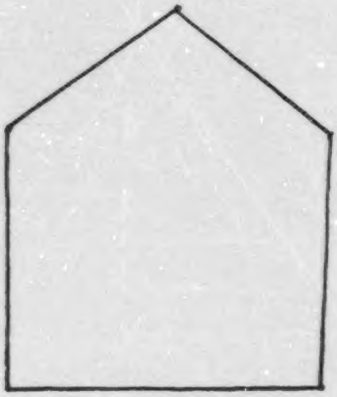
10  REM THIS PROGRAM WILL
12  REM ALLOW YOU TO VIEW
14  REM AN OBJECT FROM A
16  REM FILE CREATED BY THE
18  REM PROGRAM "DEFINE OBJECT".
20  REM
90  REM DIMENTION ARRAYS AND
92  REM SET VARIABLES.
100  DIM V(40,3),E(40,3),S(10,10)

110 D$ =  CHR$ (4)
120 L = 0:R = 279:T = 0:B = 191:S
```

```
]PR#0
```







```
     C = 280 / 192:D = 280
125  HCOLOR= 3
126  HOME : PRINT : PRINT : PRINT

130  PRINT  TAB( 5)"THIS IS A PRO
     GRAM TO VIEW AN"
140  PRINT "OBJECT FROM SEVERAL D
     IFFERENT ANGLES."
150  VTAB 10
151  INVERSE
152  HTAB 10: PRINT "DEMONSTRATIO
     N PROGRAM"
153  HTAB 9: PRINT "FOR EDUCATION
     AL USE ONLY"
154  NORMAL
155  PRINT : PRINT : PRINT
156  PRINT  TAB( 5)"PRESS <RETURN
     > TO CONTINUE";: INPUT A$
157  HOME : PRINT : PRINT : PRINT

160  PRINT  TAB( 5)"WHAT FILE IS
     THE OBJECT IN";: INPUT N$
170  PRINT D$;"OPEN";N$
180  PRINT D$;"READ";N$
190  FOR I = 1 TO 40
200  INPUT V(I,1)
210  INPUT V(I,2)
220  INPUT V(I,3)
230  NEXT I
240  FOR I = 1 TO 40
250  INPUT E(I,1)
260  INPUT E(I,2)
270 E(I,3) = 0
280  NEXT I
290  FOR I = 1 TO 10
300  FOR J = 1 TO 10
310  INPUT S(I,J)
320  NEXT J
330  NEXT I
340  PRINT D$;"CLOSE";N$
341  REM
342  REM FIND CENTER POINT
343  REM
350 P2 = V(1,2):Q2 = V(1,2)
360 P3 = V(1,3):Q3 = V(1,3)
370  FOR I = 2 TO 40
380  IF V(I,1) > P1 THEN P1 = V(I
     ,1)
390  IF V(I,1) < Q1 THEN Q1 = V(I
     ,1)
400  IF V(I,2) > P2 THEN P2 = V(I
     ,2)
410  IF V(I,2) < Q2 THEN Q2 = V(I
    ,2)
420  IF V(I,3) > P3 THEN P3 = V(I
    ,3)
430  IF V(I,3) < Q3 THEN Q3 = V(I
    ,3)
440  NEXT I
450 CX = P1 - Q1
455 CX = CX / 2
460 CX = P1 - CX
470 CY = P2 - Q2
475 CY = CY / 2
480 CY = P2 - CY
490 CZ = P3 - Q3
495 CZ = CZ / 2
500 CZ = P3 - CZ
505  REM
506  REM LOOP TO FIND A NORMAL
507  REM POINT ON EACH SIDE
508  REM
510 I = 1
520  IF S(I,1) = 0 GOTO 610
530 P1 = (V(E(S(I,1),2),1) - CX) -
     (V(E(S(I,1),1),1) - CX)
540 P2 = (V(E(S(I,1),2),2) - CY) -
     (V(E(S(I,1),1),2) - CY)
550 P3 = (V(E(S(I,1),2),3) - CZ) -
     (V(E(S(I,1),1),3) - CZ)
560 Q1 = (V(E(S(I,2),2),1) - CX) -
     (V(E(S(I,1),1),1) - CX)
570 Q2 = (V(E(S(I,2),2),2) - CY) -
     (V(E(S(I,1),1),2) - CY)
580 Q3 = (V(E(S(I,2),2),3) - CZ) -
     (V(E(S(I,1),1),3) - CZ)
581 N(I,1) = P2 * Q3 - Q2 * P3
582 N(I,2) = P3 * Q1 - Q3 * P1
583 N(I,3) = P1 * Q2 - Q1 * P2
590 I = I + 1
600  GOTO 520
605  REM
610  PRINT : PRINT : PRINT : PRINT
      TAB( 5)"THIS PROGRAM WILL A
     LLOW YOU TO"
620  PRINT "USE TWO TYPES OF PROJ
     ECTIONS,"
630  PRINT "PARALLEL AND PRESPECT
     IVE."
640  PRINT  TAB( 5)"WHICH WOULD Y
     OU PREFER:"
650  PRINT  TAB( 10)"A. PARALLEL"

660  PRINT  TAB( 10)"B. PRESPECTI
     VE"
670  GET A$: PRINT : PRINT : PRINT
```

```
675  REM
676  REM FOR PARALLEL SET
677  REM VIEWPOINT AT INFINITY
678  REM (1000), AND SET SCALE
679  REM
680  IF A$ <  > "A" GOTO 730
690 RH = 1000
700  PRINT  TAB( 5)"WHAT SCALE FA
     CTOR DO YOU WANT";: INPUT SL

710  PRINT : PRINT : PRINT
720  GOTO 810
722  REM
723  REM FOR PRESPECTIVE SET
724  REM SCALE TO 1, AND SET
725  REM VIEWPOINT.
726  REM
730  IF A$ <  > "B" GOTO 790
740 SL = 1
750  PRINT  TAB( 5)"WHAT SIZE WIN
     DOW DO YOU WANT?"
760  PRINT "THIS SIZE SHOULD BE L
     ARGER THAN THE     OBJECT.";

770  INPUT RH
780  GOTO 810
785  REM
790  PRINT : PRINT : PRINT : PRINT
      TAB( 5)"ILLEGAL ENTRY, TRY
     AGAIN.": PRINT : PRINT : PRINT

800  GOTO 640
810  PRINT : PRINT : PRINT
820  PRINT  TAB( 5)"HOW MANY DEGR
     EES OFF THE X AXIS DO"
830  PRINT "YOU WANT THE STARTING
      VIEWPOINT";: INPUT TH
840 TH = TH * 3.141592654 / 180
850  PRINT "HOW MANY DEGREES OFF
     THE Z-AXIS";: INPUT PH
860 PH = PH * 3.141592654 / 180
870  GOSUB 1100
875  GOSUB 7250
880  PRINT : PRINT : PRINT
890  PRINT  TAB( 5)"DO YOU WANT T
     O"
900  PRINT  TAB( 10)"R. ROTATE TH
     E OBJECT"
910  PRINT  TAB( 10)"A. ALTER PRO
     JECTION TYPE"
920  PRINT  TAB( 10)"E. EXIT PROG
     RAM"
```

```
930  GET A$
940  IF A$ = "A" GOTO 610
950  IF A$ <  > "R" GOTO 1090
960  PRINT : PRINT : PRINT
970  PRINT  TAB( 5)"HOW MANY DEGR
     EES ALONG THE"
980  PRINT "X-AXIS DO YOU WANT IT
      ROTATED";: INPUT TE
990  PRINT "HOW MANY DEGREES ALON
     G THE Z-AXIS";: INPUT PI
1000  PRINT "HOW MANY STEPS DO YO
     U WANT";: INPUT L
1010 TE = TE / L:PI = PI / L
1020 TE = TE * 3.141592654 / 180
1030 PI = PI * 3.141492654 / 180
1040  FOR K = 1 TO L
1050 TH = TH + TE:PH = PH + PI
1060  GOSUB 1100
1065  GOSUB 7250
1070  NEXT K
1080  GOTO 880
1090  TEXT : END
1092  REM
1094  REM SUBROUTINE: REMOVE
1096  REM HIDDEN LINES.
1098  REM
1100 S1 =  SIN (TH)
1101 S2 =  SIN (PH)
1102 C1 =  COS (TH)
1104 C2 =  COS (PH)
1110 XE = RH * S2 * C1
1115 YE = RH * S2 * S1
1120 ZE = RH * C2
1124  REM
1125  REM LOOP: CHECK FOR VISIBLE

1126  REM SURFACE
1127  REM
1130 I = 1
1135  FLASH : PRINT "WAIT FOR IMA
     GE": NORMAL
1140  IF S(I,1) = 0 GOTO 1260
1150 WX = XE - (V(E(S(I,1),1),1) -
     CX)
1160 WY = YE - (V(E(S(I,1),1),2) -
     CY)
1170 WZ = ZE - (V(E(S(I,1),1),3) -
     CZ)
1180  IF N(I,1) * WX + N(I,2) * W
     Y + N(I,3) * WZ > 0 GOTO 124
     0
1184  REM
1185  REM LOOP: SET VISIBLE
```

```
1186  REM EDGES
1187  REM
1190  FOR J = 1 TO 10
1200  IF S(I,J) = 0 GOTO 1230
1210 E(S(I,J),3) = 1
1230  NEXT J
1240 I = I + 1
1250  GOTO 1140
1253  REM NESTED LOOPS: FIND
1254  REM ALL EDGES THAT
1255  REM ARE SET TO BE DRAWN
1256  REM TWICE AND RESET
1257  REM EXTRA EDGES.
1258  REM
1260  FOR I = 1 TO 40
1262  IF I = 10 THEN  FLASH : PRINT
     "STILL PROCESSING"
1264  IF I = 20 THEN  PRINT "ONE
     MOMENT PLEASE"
1266  IF I = 30 THEN  INVERSE : PRINT
     "THERE IS ABSOLUTLY NO CAUSE
      FOR CONCERN": NORMAL
1270  IF E(I,3) <  > 1 GOTO 1330
1280  FOR J = 1 TO 40
1285  IF J = I GOTO 1320
1290  IF E(I,1) <  > E(J,1) AND E
     (I,1) <  > E(J,2) GOTO 1320
1300  IF E(I,2) <  > E(J,1) AND E
     (I,2) <  > E(J,2) GOTO 1320
1310 E(J,3) = 0
1320  NEXT J
1330  NEXT I
1350  RETURN
7200  REM
7210  REM DRAW THE OBJECT
7220  REM
7230  PRINT " ": PRINT " ": PRINT
     " ": PRINT " ": PRINT " "
7250  HGR
7260  POKE 34,20
7270  HOME
7700 I = 1
7800  IF E(I,1) = 0 GOTO 9850
7805  IF E(I,3) = 0 GOTO 9700
7850 RE = 0
7900 X = V(E(I,1),1) - CX
8000 Y = V(E(I,1),2) - CY
8100 Z = V(E(I,1),3) - CZ
8200 X1 =  - X * S1 + Y * C1
8300 Y1 =  - X * C1 * C2 - Y * S1
     * C2 + Z * S2
8400 Z1 =  - X * S2 * C1 - Y * S2
     * S1 - Z * C2 + RH
     L) + 140
8600 YF = 96 - (D * (Y1 / Z1) * S
     L)
8700 X = V(E(I,2),1) - CX
8800 Y = V(E(I,2),2) - CY
8900 Z = V(E(I,2),3) - CZ
9000 X2 =  - X * S1 + Y * C1
9100 Y2 =  - X * C1 * C2 - Y * S1
      * C2 + Z * S2
9200 Z2 =  - X * S2 * C1 - Y * S2
      * S1 - Z * C2 + RH
9300 XT = (D * (X2 / Z2) * SC * S
     L) + 140
9400 YT = 96 - (D * (Y2 / Z2) * S
     L)
9440  REM
9450  REM CALL CLIP
9460  REM
9500  GOSUB 11000
9550  IF RE = 1 GOTO 9700
9600  HPLOT XF,YF TO XT,YT
9700 I = I + 1
9800  GOTO 7800
9850  FOR I = 1 TO 40:E(I,3) = 0:
     NEXT I
9900  PRINT "PRESS ANY KEY TO CON
     TINUE?": GET A$
10000  RETURN
10100  PRINT "DO YOU WISH TO:"
10200  PRINT  TAB( 10)"C. CHANGE
     VIEW"
10300  PRINT  TAB( 10)"E. EXIT PR
     OGRAM"
10400  GET A$: PRINT : PRINT : PRINT

10500  IF A$ = "C" GOTO 625
10600  REM
10610  REM SUBROUTINE: CLIP
10620  REM ALL LINES SO THAT
10630  REM THEY DO NOT GO
10640  REM PAST THE SCREEN
10650  REM EDGE
10660  REM
11000 L1 = 0:R1 = 0:T1 = 0:B1 = 0
     :L2 = 0:R2 = 0:T2 = 0:B2 = 0

11090  REM CLIP FIRST POINT
11100  IF XF >  = L GOTO 11300
11200 L1 = 1
11300  IF XF <  = R THEN 11500
11400 R1 = 1
11500  IF YF >  = T THEN 11700
11600 T1 = 1
11700  IF YF <  = B THEN 11900
11790  REM CLIP SECOND POINT
11800 B1 = 1
11900  IF XT >  = L THEN 12100
12000 L2 = 1
12100  IF XT <  = R THEN 12300
12200 R2 = 1
```

```
12300  IF YT >  = T THEN 12500
12400 T2 = 1
12500  IF YT <  = B THEN 12700
12600 B2 = 1
12700  IF L1 <  > 0 OR L2 <  > 0 OR
     R1 <  > 0 OR R2 <  > 0 GOTO
     12900
12800  IF T1 = 0 AND T2 = 0 AND B
     1 = 0 AND B2 = 0 THEN  RETURN
12900  IF L1 <  > 0 AND L2 <  > 0
     THEN RE = 1
12910  IF R1 <  > 0 AND R2 <  > 0
     THEN RE = 1
12930  IF T1 <  > 0 AND T2 <  > 0
     THEN RE = 1
12940  IF B1 <  > 0 AND B2 <  > 0
     THEN RE = 1
13000  IF RE = 1 THEN  RETURN
13100  IF L1 <  > 1 GOTO 13500
13200 YF = YF + (YT - YF) * (L -
     XF) / (XT - XF)
13300 XF = L
13400  GOTO 11000
13500  IF R1 <  > 1 GOTO 13900
13600 YF = YF + (YT - YF) * (R -
     YF) / (XT - XF)
13700 XF = R
13800  GOTO 11000
13900  IF T1 <  > 1 GOTO 14300
14000 XF = XF + (XT - XF) * (T -
     YF) / (YT - YF)
14100 YF = T
14200  GOTO 11000
14300  IF B1 <  > 1 GOTO 14700
14400 XF = XF + (XT - XF) * (B -
     YF) / (YT - YF)
14500 YF = B
14600  GOTO 11000
14700  IF L2 <  > 1 GOTO 15100
14800 YT = YF + (YT - YF) * (L -
     XF) / (XT - XF)
14900 XT = L
15000  GOTO 11000
15100  IF R2 <  > 1 GOTO 15500
15200 YT = YF + (YT - YF) * (R -
     XF) / (XT - XF)
15300 XT = R
15400  GOTO 11000
15500  IF T2 <  > 1 GOTO 15900
15600 XT = XF + (XT - XF) * (T -
     YF) / (YT - YF)
15700 YT = T
15800  GOTO 11000
15900  IF B2 <  > 1 GOTO 11000
16000 XT = XF + (XT - XF) * (B -
     YF) / (YT - YF)
16100 YT = B
16200  GOTO 11000

]
```

```
10 ' MODEL III PLOTTER ROUTINE
20 '
30 GOSUB 160
40 CLEAR 1000
50 '
52 ' ********** ENTER NEW LINE NUMBERS BETWEEN 500 AND 600
54 ' ********** THEY SHOULD BE OF THE FORM
55 ' ********** LPRINT " ;: XXXXXXXXXXXX "
56 ' ********** WHERE XXXX IS LEGITIMATE PLOTTER COMMANDS
60 '
70 GOSUB 499
80 GOTO 310
90 H = USR3(0)
100 PRINT
110 GOTO 80
120 '
130 '
140 '
150 '
160 ' SET UP SERIAL PORT
170 DEFUSR1 = &H5A
180 POKE 16890,&HFF
190 BR=10
200 POKE 16888,(16*BR)+BR
210 POKE 16889,(127)
220 X=USR1(0)
230 DEFUSR0=&H006C
240 POKE &H4220,82
250 POKE &H4221,79
260 POKE &H4222,80
270 POKE &H4223,82
280 X = USR0(0)
290 DEFUSR3=&H0050
300 RETURN
310 '
320 DEFUSR2=&H69
330 X=USR2(0)
340 CLS: END
499 '
601 LPRINT " :: U P0 H @"
602 RETURN
```

```
 RADIO SHACK  TRS-80 AUTHOR I      Lesson: TEXT2
Version: 01/10/84       Page: 02 of 03   Page type: TEXT

--------------------------------------------------------------------
'   .      PROGRAM 7. CABINET DRAWING ROUTINES                     '
'   .                                                              '
'   .        This program was designed to demonstrate the          '
'   .     ability of a small, inexpensive (relatively) system      '
'   .     to aid in drafting and design fields.                    '
'   .                                                              '
'   .        The program draws fairly clear and numerous           '
'   .     combinations of kitchen cabinets.  An entire             '
'   .     kitchen can be easily designed and redesigned            '
'   .     completely from menu choices.                            '
'   .                                                              '
'   .        Some knowledge of drafting terms is helpful,          '
'   .     but not neccessary.  A few experiments will              '
--------------------------------------------------------------------
```

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 RADIO SHACK  TRS-80 AUTHOR I      Lesson: TEXT2
Version: 01/10/84        Page: 03 of 03   Page type: TEXT

-------------------------------------------------------------------
!   .                                                             !
!   .       illustrate the different cabinets available          !
!   .       if the names are not familiar.                        !
!   .                                                             !
!   .         In order to draw cabinets that are left of          !
!   .       the current pen position, a NO CABINET MOVE           !
!   .       LEFT choice should be selected and then the           !
!   .       appropriate distance in inches entered.  A            !
!   .       wall cabinet is one instance of this if it is         !
!   .       requested after drawing a base cabinet.               !
!   .                                                             !
!   .         The plotter should be reset to REMOTE  before       !
!   .       and after each use or if a mistake is made.           !
-------------------------------------------------------------------
```

```
10 '********* CABINET DRAWING ROUTINES ***************
20 '
30 '  THIS PROGRAM WILL AID IN THE LAYOUT OF CABINETS.
40 'THERE ARE SEVERAL CHOICES OF SCALE AND DIMENSIONS
50 'TO CHOSE FROM.  ALL SELECTIONS ARE MENU DRIVEN AND
60 'INPUT PROTECTED. THE PROGRAM IS DESIGNED TO RUN ON
70 'TRS-80 MODEL III WITH A MULTI PEN PLOTTER.
72 '  THIS PROGRAM IS DESIGNED SO ADDITIONAL ROUTINES CAN
73 'BE ADDED EASILY. AN ADDITION TO THE MENU AND JUMP
74 'TABLE WILL SET UP ANY NEW SUBROUTINE ADDED AT THE END.
75 '   THERE ARE EXAMPLES OF SEVERAL TYPES OF PLOTTER ROUTINES
76 ' IN THIS LISTING. THE SCALE USED IS 1/2 IN. = 1 FOOT. BUT
77 ' THIS IS ALSO EASILY CHANGED BY REPLACING THE VERTICAL
78 ' CONSTANTS BY A VARIABLE AS THE HORIZONTAL VALUES ARE.
79 ' THE SCALE MENU WAS REMOVED IN THIS VERSION DUE TO TIME
80 ' LIMITATIONS FROM LINE NUMBERS 350-400.
81 '
82 '                          MIKE RAINES    6-83
83 '
90 ON ERROR GOTO 5000
95 CLEAR 4500
100 GOSUB 7000 '        ** SET UP PLOTTER PORTS
110 '
120 ' ***************** MAIN MENU **********************
130 '
140 CLS:PRINT@70,"PLEASE PRESS ENTER AFTER EVERY ANSWER "
150 PRINT@463,"WHAT IS YOUR FIRST NAME ?"
160 INPUT FIR$
170 PRINT@591,"WHAT IS YOUR LAST NAME ?"
180 INPUT LN$
190 PRINT@778,"WHAT CLASS ARE YOU ENROLLED IN ? "
200 INPUT CL$
210 CLS
212 PRINT@335,"WHAT SCHOOL ARE YOU FROM ?"
213 INPUT SC$
214 PRINT@463,"ENTER THE DATE IN THE  FORM OF MO-DAY-YR":PRINT
215 INPUT DA$
216 '
217 XX=0: GOSUB 8000 ' DRAW BORDER AND TITLE
218 '
400 S = 8.333
405 '
407 ' **************  CABINET TYPE MENU *****************
410 '
411 CLS:PRINT@332,"   WHICH ROOM ARE THE CABINETS FOR ? " :PRINT
420 '
430 CLS:PRINT"CHOOSE THE NUMBER OF THE CABINET TO BE DRAWN ":PRINT
432 FL=0
440 PRINT "     (1)   BASE                   (14)   WALL "
450 PRINT "     (2)   BLIND RIGHT BASE       (15)   BLIND RIGHT WALL"
460 PRINT"     (3)   BLIND LEFT BASE        (16)   BLIND LEFT WALL"
470 PRINT "     (4)   FOUR DRAWER BASE       (17)   OVEN     "
480 PRINT "     (5)   SINK                   (18)   DOUBLE OVEN"
490 PRINT "     (6)   DISHWASHER             (19)   FURRED CEILING"
500 PRINT "     (7)   TRASH COMPACTOR        (20)   STORAGE"
510 PRINT "     (8)   RANGE                  (21)   DESK  "
520 PRINT "     (9)   TRAY STORAGE           (22)   MANUAL CONTROL
```

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```
530 PRINT "   (10)   WALL CAB.              (23)   RETURN TO MAIN MENU"
540 PRINT "   (11)   ROTATING CORNER RT. (24)   NO CAB. MOVE RT. "
550 PRINT"   (12)  TROMG CORNER LT. (25)   NO CAB. MOVE LT.
552 PRINT "   (13)   WAALL W/ HOOD          (26)   EXIT PROGRAM "
560 INPUT TY: IF TY = 23 THEN 120
561 IF TY = 26 THEN 4950
562 IF TY = 24 THEN  GOSUB 3000
563 IF TY = 25 THEN GOSUB 3500
564 IF FL = 1 THEN 430
565 IF TY>0AND TY<28 THEN570
566 CLS:PRINT"ENTER A NUMBER BETWEEN 1 AND 25 ONLY."
567 FOR X=1TO 150:NEXT X:GOTO 430
570 IF TY >13 AND TY <17 THEN GOSUB 1500
573 IF TY = 22 OR TY = 6  OR TY = 7   THEN 642
575 GOSUB 2500
580 XX = XX + WY
600 IF TY=1 AND WY=27 THEN GOTO  12000
642 GOSUB 9000
644 GOTO 430
849 '
850 ' MANUEL PLOT ROUTINE *************
855 LPRINT C$
860 H = USR3(0)
865 RETURN
900 '
905 ' PLOTTER CONTROL ROUTINE ************
910 '
915 LPRINT"  ;:   R  "
920 LPRINT " ";X;" ";Y;" "
922 FL=1
925 H = USR3(0) ' **** WAIT FOR BUFFER RESPONSE ****
930 RETURN
932 '
934 ' ***** SUBROUTINE DOWN ******
936 '
938 LPRINT " ;: R D "
940 RETURN
942 '
944 ' ****** SUBROUTINE UP *******
946 '
948 LPRINT " ;: R U "
950 RETURN
952 '
954 ' ****** SUBROUTINE ASSIGN ORIGIN **
956 '
958 LPRINT " ;: O "
960 RETURN
962 '
964 ' ******* SUBROUTINE GOTO ORIGIN **
966 '
968 LPRINT " ;: A 0,0 R "
970 RETURN
972 '
974 ' ******* SUBROUTINE KNOB **********
976 '
978 LPRINT ";: CC 0,4 "
980 RETURN
1000 '
1010 ' ***** SINK AND BASE ROUTINES **
1020 '
1030 WID = INT(S*WY)
1032 GOSUB 934
```

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```
1040 X=WID: Y = 0 :GOSUB 900: GOSUB 944
1041 IF TY = 5 OR TY = 9 OR TY = 10  OR TY = 4 OR TY = 6 OR
     TY = 7 THEN 1050
1042 SH=INT (17.5*S)
1043 GOSUB 944
1044 X=0    :Y=SH:GOSUB 900:GOSUB 934
1045 X=-WID:Y=0
1046 LPRINT " :: L3"
1047 GOSUB 900:GOSUB 944
1048 LPRINT " :: L0 A 0,0 R D "
1050 Y = 288 : X = 0 :GOSUB 900
1060 Y = 0 : X = -WID : GOSUB 900
1070 Y = -288    : X = 0: GOSUB 900
1080 X = 0 : Y = 33  : GOSUB 900
1090 X = WID : Y = 0: GOSUB 900
1100 GOSUB 944
1110 X = 0:Y = 267:GOSUB 900
1120 GOSUB 934
1122 X = -WID : Y = 0 :GOSUB 900
1124 GOSUB 944
1126 X=4 :Y=-263    :GOSUB 900
1128 GOSUB 934: IF TY = 4 OR TY = 6 OR TY = 7 THEN RETURN
1130 IF WY > 27 THEN 1200
1131 '
1132 ' **************** ONE DOOR ROUTINE *****
1134 '
1136 WID = WID - 8
1138 X=WID:Y=0:GOSUB 900
1140 X=0:Y=191 : GOSUB 900
1142 X=-WID:Y=0: GOSUB 900
1144 X=0:Y=-191    : GOSUB 900
1146 GOSUB 944
1148 X=0:Y=197 : GOSUB 900
1150 GOSUB 934
1152 X=WID:Y=0:GOSUB 900
1154 X=0:Y=50 :GOSUB 900
1156 X=-WID:Y=0:GOSUB 900
1158 X=0:Y=-50  :GOSUB 900
1160 GOSUB 944
1162 X=INT(WID/2):Y=25 :GOSUB 900
1163 IF TY = 5 OR TY = 8 THEN 1166
1164 GOSUB 974
1166 CLS :PRINT "DO YOU WANT THE KNOB ON THE LEFT (L) OR
     RIGHT (R) OF THE CABINET DOOR ? "
1168 K$ = INKEY$ : IF K$ = "" THEN 1168
1170 IF K$ = "L" THEN  1176
1172 IF K$="R" THEN 1184
1174 GOTO 1166
1176 X=-INT((WID/2)-20):Y=-64  :GOSUB 900
1178 GOSUB 974:GOSUB 944:WID = WID+8
1180 X=0:Y=-(260 ):GOSUB 900
1182  GOTO 1400 ' GO TO LABEL ROUTINE
1184 X=INT(WID/2-20):Y=-64:GOSUB 900
1186 GOSUB 974: GOSUB 944: WID = WID + 8
1188 X=-(WID-40): Y=-252  : GOSUB 900
1190 '
1193 GOTO 1400 ' GOTO LABEL ROUTINE
1200 '
```

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```
1202 '  ****** TWO DOOR ROUTINE  *******
1204 '
1206 GOSUB 934:DWI=INT((WID-14)/2)
1208 X=DWI:Y=0 :GOSUB 900
1210 X = 0:Y=191 :GOSUB 900
1212 X=-DWI:Y=0:GOSUB 900
1214 X=0: Y=-191   : GOSUB 900
1216 GOSUB 944
1218 X=DWI+6:Y=0:GOSUB 900
1220 GOSUB 934
1222 X=DWI:Y=0:GOSUB 900
1224 X=0:Y=191 : GOSUP 900
1226 X=-DWI:Y=0:GOSUB 900
1228 X=0:Y=-191  :GOSUP 900
1230 GOSUP 944
1232 X=0:Y=197 :GOSUB 900
1234 GOSUB 934
1236 X=DWI:Y=0 :GOSUB 900
1238 X=0:Y=50 : GOSUB 900
1239 IF TY = 5 OR TY = 8 THEN 1270
1240 X=-DWI:Y=0: GOSUB 900
1242 X=0:Y=-50    :GOSUP 900:GOSUB944
1244 X=-4:Y=0:GOSUB 900:GOSUB 934: X=0:Y=50:GOSUB 900:X=-DWI
     :Y=0:GOSUB 900
1245 X=0: Y=-50   : GOSUB 900:X=DWI:Y=0:GOSUB 900
1246 GOSUB 944:X=INT(DWI/2):Y=25 : GOSUB 900:GOSUB 934
1248 GOSUB 974:GOSUB 944
1250 X=-(DWI):Y=0:GOSUB 900
1252 GOSUB 974:GOSUB 944
1254 X=INT((DWI/2)-20) :GOSUB 900
1255 X=0 :Y=-64:GOSUB 900
1256 GOSUB 974:GOSUB 944
1258 X=46: Y=0 :GOSUB 900:GOSUB 974:GOSUB 944
1260 X=-INT(10+DWI):Y=-260   : GOSUB 900
1262 GOTO 1400
1265 ' ***** SINK ROUTINE *****
1270 X = -(2*DWI+6):Y = 0:GOSUB 900
1272 X = 0: Y = -50: GOSUB 900
1274 X = DWI + 6:Y = 0: GOSUB 900
1276 GOSUB 944
1278 X = -INT(DWI/2+6): Y = 0 :GOSUB 900
1279 X=0:Y=14: GOSUB 900
1280 GOTO 1254
1400 ' LABEL ROUTINE *************
1401 IF TY = 2 OR TY = 3 OR TY = 9 OR TY = 10 OR TY = 8 THEN RETURN
1402 SB$="B."
1403 IF TY=5 THEN SB$="S."
1404 LPRINT " ;: S12 "'+ SB$
1406 LPRINT STR$ (WY);CHR$(95)
1407 GOSUB 964
1408 LPRINT " U A 0,0 "
1409 RETURN
1410 '
1500 '*************DETERMINE HEIGHT ****************
1501 '
1510 CLS:PRINT"CHOOSE AN APPROPRIATE HEIGHT FOR THE CABINET."
1520 PRINT
1530 PRINT"WALL CABINETS CAN BE 12, 15, 18, 24 OR 32 INCHES HIGH"
```

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```
1550 PRINT "MUST ENTER THE HEIGHT OF THE CHOICES ABOVE, YOU WISH YOUR"
1551 PRINT"CABINET TO BE"
1560 INPUT HT
1570 IF HT<>12AND HT<>15ANDHT<>18AND HT<>24ANDHT<>32ANDHT<>44ANDHT
     <>63ANDHT<>84 THEN1600
1580 RETURN
1590 '
1600 PRINT"ENTER ONE OF THE SELECTIONS ONLY.":FOR G= 1 TO 150:NEXT
     G: GOTO 1500
2499 '
2500 ' ************ DETERMINE WIDTH ***************
2501 '
2510 CLS:PRINT"  CHOOSE AN APPROPRIATE WIDTH FOR YOUR CABINETS. THE "
2520 PRINT" CABINETS LISTED BELOW COME IN THREE (3) INCH INCREMENTS
     ONLY.  CHOOSE YOUR WIDTH IN THE RANGES LISTED FOR THE CABINET WA
NTED.  ENTER YOUR VALUE IN INCHES."
2540 PRINT"          KITCHEN              *"
2550 PRINT "-------------------------------"
2560 PRINT"    BASE           12-51      *"
2570 PRINT"    BLIND BASES 36-51      *"
2580 PRINT"    SINK           24-72      *"
2590 PRINT"    WALL           24-51      *"
2600 PRINT"    BLIND WALL    24-75      *"
2610 PRINT"    OVEN           24-36      *"
2620 PRINT"    BROOM          12-48      *"
2630 PRINT"    STORAGE        12-48      *"
2635 PRINT"    RANGE          24-51      * "
2636 PRINT"    DESK           24-36      * "
2640 '
2650 INPUT WY:TEM=WY
2660 FOR R=1 TO 35
2665 TEM=TEM-3
2670 IF TEM=0THEN R=35
2672 NEXT R
2673 IF WY<06OR WY >51  THEN2676
2674 IF TEM=0 THEN 2900
2676 PRINT " ENTER A VALUE IN THE RANGE ONLY":FOR F=1 TO 1000:
     NEXTF:GOTO 2500
2701 GOTO 4950
2900 RETURN
2999 '
3000 ' MOVE RIGHT ROUTINE *************
3005 '
3010 CLS:PRINT "ENTER THE DISTANCE YOU WISH TO MOVE RIGHT IN INCHES"
3015 INPUT MR:X = INT(MR * S):Y = 0
3020 GOSUB 900:GOSUB 954
3022 XX = XX + ML
3025 RETURN
3499 '
3500 'MOVE LEFT ROUTINE **********
3505 '
3510 CLS:PRINT "ENTER THE DISTANCE YOU WISH TO MOVE LEFT IN INCHES"
3515 INPUT ML:X=-INT(ML*S):Y=0
3520 GOSUB 900 :GOSUB 954
3525 RETURN
4950 I PRINT ":: P0 H Z a " :DEFUSR2=&H69:X=USR2(0)
4951 H=USR3(0)
4999 CLS:PRINT@460,"YOU HAVE LEFT THE PROGRAM.":END
5000 CLS:PRINT@468,"**** INPUT ERROR **** "
```

```
5001
5002 '
5010 PRINT@70,"MAKE SURE WHAT YOU ENTER STARTED WITH A LETTER
     IF YOU ARE ANSWERING YOUR NAME OR CLASS."
5020 PRINT "  MAKE SURE YOU ONLY ENTER A NUMBER FOR MENU
     SELECTIONS."
5030 RESUME
7000 CLS:VM= 15360
7010 PRINTCHR$(23):PRINT@394,"ARCHITECHTURAL DETAILS "
7020 PRINT@532,"KITCHEN "
7030 CNT=0:CHAR=146
7040 FOR G = 194 TO 250
7050 POKE VM+ G,CHAR:NEXT G
7060 FOR H =  770 TO826
7070 POKE VM+H,CHAR:NEXTH
7080 FOR I = 194 TO 770 STEP 64
7090 POKE VM+I,CHAR:NEXT I
7100 FOR J = 250 TO 826 STEP 64
7110 POKE VM+J,CHAR: NEXTJ
7120 IF CNT=2 THEN 7150
7130 CNT=CNT+1:CHAR = CHAR + 10
7140 FOR T = 1 TO100:GOTO7040
7150 FOR T = 1 TO 1000:RETURN
7200 RETURN
7999 '
8000 ' PLOTTER SET UP ROUTINE ************************
8010 '
8020 DEFUSR1 = &H5A
8030 POKE 16890,&HFF   ' *** WAIT ***
8040 BR = 10              'SET BAUD RATE AT 2400 ******
8050 POKE 16888,(16*BR)+BR
8060 POKE 16889,127
8070 x=USR1(0)
8080 DEFUSR0=&H006C
8090 POKE &H4220,82
8100 POKE &H4221,79   ' *** R0 IS RS 232 OUTPUT ***
8110 POKE &H4222,80
8120 POKE &H4223,82
8130 X=USR0(0)
8140 DEFUSR3 = &H0050
8160 ' ***** DRAW INITIAL OUTLINE ******
8170 '
8180 LPRINT" X;: P1 L0  HAD 1850,0 1850,1400 0,1400 0,0 0,100
     1850,100 U 50,30 "; CHR$(94)
8190 LPRINT "  S12 NAME: " ; " ";FIR$ ; " ": LN$ :CHR$(95)
8191 LPRINT" ;: A 600,30 ";CHR$(94)
8192 LPRINT " ;: S12 CLASS:   " ; " ";CL$:CHR$(95)
8193 LPRINT" ;: A 925,30"; CHR$(94)
8194 LPRINT " S12 SCHOOL: ";" "; SC$:CHR$(95)
8195 LPRINT " ;: A 1600,30 ";CHR$(94)
8196 LPRINT ";: S12 ";" ";DA$;CHR$(95)
8198 LPRINT ";: P1 HAU 100,400 O R ";CHR$(94)
8999 RETURN
9000 '
9010 ' ************* JUMP ROUTINE **************
```

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```
9020 '
9030 '  *** THIS SECTION DECIDES WHERE TO GO TO DRAW
     THE CABINET REQUESTED.
9035 IF TY=1 OR TY = 5 THEN GOSUB 1000
9040 IF TY = 14 THEN GOSUB 13000
9045 IF TY = 2 OR TY = 3 THEN GOSUB 13500
9050 IF TY = 15 OR TY = 16 THEN GOSUB 13800
9055 IF TY = 10 OR TY = 9 THEN GOSUB 13900
9060 IF TY = 22 THEN GOSUB 14000
9065 IF TY = 8 THEN 14200
9070 IF TY = 6 OR TY = 7 OR TY = 4 THEN GOSUB 14500
9075 IF TY = 18 OR TY = 17 OR TY = 20 THEN GOSUB 15000
9080 IF TY = 13 THEN GOSUB 16000
9085 IF TY = 12 OR TY = 11 THEN GOSUB 16100
9090 IF TY = 21 THEN GOSUB 16300
9095 IF TY = 19 THEN GOSUB 16500.
9998 RETURN
12000 ' ********  27 INCH BASE  *********
12005 '
12007 LPRINT ";: RD 225,0 O U 0,144 D L3 -225,0 U L0 A 0,0 R "
12010 LPRINT " ;: D 0.288 -225,0 0,-288 0.33 225.0 U 0,267 D -225.
      0 U 0.-300 4.37 D 105.0 0.191 -105.0 0. 191 U 112.0 D 105.0
      0.191
-105,0 0,-191 U -112,197 D 217,0 0.50 -217,0 0,-50 U 108,25 D CC
     0,4 U  23,-64 D CC 0,4 U 47,0 D CC 0,4 U -136,-195 "
12012 LPRINT " 20,-60 S12 B. 27 ";CHR$(95)
12014 LPRINT " U A 0,0 "
12015 GOTO 430
12050 '
13000 '
13005 ' *************** WALL CABINET ROUTINE **********
13010 '
13015 GOSUB 944
13020 X=0 :Y=INT(84*S): GOSUB 900
13025 GOSUB 934
13030 XW= INT (S*WY)
13035 YW = INT(S*HT)
13040 X = XW:Y = 0:GOSUB 900: GOSUB 954
13045 X=0 : Y = -YW: GOSUB 900
13050 X = -XW: Y = 0: GOSUB 900
13055 X = 0 : Y = YW: GOSUB 900
13060 GOSUB 944 '                           ' PICK UP PEN
13065 X = 4: Y = -4 '
13070 IF WY> 24 THEN 13195
13071 '
13072 '  *****ONE DOOR ROUTINE ****
13073 '
13075 XW = XW - 8 :YW = YW -8:GOSUB 900: GOSUB 934 'PEN DOWN.
13080 X = XW: Y = 0: GOSUB 900
13085 X = 0 : Y = -YW: GOSUB 900
13090 X = -XW: Y = 0: GOSUB 900
13095 X = 0: Y = YW : GOSUB 900
13100 GOSUB 944 '                                PEN UP
13105 CLS: PRINT "DO YOU WANT THE KNOB ON THE LEFT (L) OR THE
      RIGHT(R) OF THE CABINET ?"
13110 K$= INKEY$:IF K$= "" THEN 13110
13115 IF K$ = "R" THEN 13135
13120 '                        LEFT KNOB
```

```
13125 X = 20 :Y = -YW + 20 :GOSUB 900: GOSUB 974:GOSUB 944
13130 GOSUB 964: GOTO 13150
13135 '                               RIGHT KNOB
13140 X = XW - 20: Y = -YW + 20: GOSUB 900: GOSUB 974:GOSUB 944
13145 GOSUB 964
13150 IF HT < 20 THEN 13325 '    GOTO LABEL ROUTINE
13155 X = 0 : Y = -INT( HT/2*S)
13156 IF HT <30 THEN 13164
13157 X=0:Y=-INT(HT/3*S): GOSUB 900: GOSUB 934
13158 LPRINT " :: L3 "
13159 X=-(XW+8):Y=0: GOSUB 900:GOSUB 944
13160 X=XW+8:Y=0: GOSUB 900
13161 X=0:Y=-INT(HT/3*S)
13164 GOSUB 900:GOSUB 934
13165 LPRINT " ;: L3"
13170 X = -(XW+8): Y = 0: GOSUB 900
13175 GOSUB 944
13180 LPRINT "L0 A 0,0 R U"
13185 GOTO 13325 '    GOTO LABEL ROUTINE
13190 '
13195 ' **** TWO DOOR ROUTINE ****
13197 '
13200 GOSUB 900: GOSUB 934: YW = YW - 8
13205 DWI = INT(((S*WY)-14)/2)
13210 X = DWI: Y = 0: GOSUB 900
13215 X = 0: Y = -YW : GOSUB 900
13220 X = -DWI: Y = 0:GOSUB 900
13225 X = 0 :Y = +YW: GOSUB 900: GOSUB 944
13230 X = DWI + 6: Y = 0: GOSUB 900
13235 GOSUB 934: X = DWI: Y = 0: GOSUB 900
13240 X = 0: Y = -YW: GOSUB 900
13245 X = -DWI: Y = 0: GOSUB 900
13250 X = 0: Y =  YW: GOSUB 900
13255 GOSUB 944: X = 20: Y = -YW+20 :GOSUB 900
13260 GOSUB 974:GOSUB 944 '      DRAW RIGHT KNOB
13265 X = -46: Y = 0: GOSUB 900
13270 GOSUB 974: GOSUB 944: GOSUB 964:GOSUB 944
13271 X=0:Y=-HT*S: GOSUB 900
13272 IF HT < 20 THEN 13325
13275  IF HT < 30 THEN 13284
13276 FOR P = 1 TO 2
13277 X=0: Y=INT(HT/3*S):GOSUB 900
13278 GOSUB 934
13279 LPRINT " ;:L3 "
13280 X=-(XW): Y=0: GOSUB 900
13281 GOSUB 944:X=XW:Y=0:GOSUB 900:NEXT P
13282 LPRINT "L0 A 0,0 R U"
13283 GOTO 13325
13284 X=0: Y=INT(HT/2*S): GOSUB 900
13285 GOSUB 934
13300 LPRINT ";: L3"
13305 X = -(XW): Y = 0: GOSUB 900
13310 LPRINT "L0 U A 0,0 R "
13320 '
13324 GOSUB 964
13325 ' ****LABEL ROUTINE *****
13327 GOSUB 964: IF TY = 13 THEN RETURN
```

```
13328 X = XW-10:IF TY=16 THEN X=X-80
13329 IF WY = 12 THEN X = X-20
13330 Y = -300 :GOSUB 900
13332 WL$ = "W."
13334 IF TY = 15 THEN WL$ = "B.R.W."
13335 IF TY = 15 OR TY = 16 THEN WY = WY + 12
13336 IF TY = 16 THEN WL$ = "B.L.W."
13337 IF TY = 13 THEN WL$=" W/H"
13340 LPRINT "  ;: S12 "; +WL$;CHR$(94)
13342 LPRINT STR$(HT)+STR$(WY); CHR$(95)
13345 GOSUB 944: GOSUB 964
13350 X = 0: Y =-INT(84*S):GOSUB 900
13370 RETURN
13500 '
13505 ' **** BLIND RIGHT AND LEFT BASE ROUTINES ***
13510 '
13520 WY = WY - 24
13525 IF TY = 3 THEN 13540
13530 GOSUB 1000 '                DRAW WY-24 BASE
13535 '           BLIND RIGHT
13538 '
13540 GOSUB 964:XW = INT(24*S): YH = 288: GOSUB 934
13545 X = XW : Y = 0: GOSUB 900
13550  GOSUB 954
13555 X = 0: Y = YH :GOSUB 900
13560 X = -XW: Y = 0: GOSUB 900
13565 X = 0 : Y = -YH : GOSUB 900
13570 X = 0 :Y = 33 : GOSUB 900
13575 IF TY = 3 OR TY = 12 THEN 13635
13580 '
13585 X = 33:Y = 0: GOSUB 900
13590 LPRINT ";: L3 "
13595 X= (XW-33): Y =0: GOSUB 900
13600 LPRINT" ;: L0 U "
13605 X = -(XW-33):Y = 0: GOSUB 900
13610 GOSUB 934
13615 X = 0:Y = -33:GOSUB 900
13620 X = 0 :Y= 33: GOSUB 900: X=(XW-33):Y=255:GOSUB 900
13625 X = -XW: Y = 0: GOSUB 900: X = XW: Y = -255: GOSUB 900
      900:GOSUB 944:GOSUB 964: GOTO 13750
13630 GOSUB 944: X=0:Y=267:GOSUB 900: GOSUB 934:X=-XW:Y=0:GOSUB
13635 '          BLIND LEFT
13637 GOSUB 934:X=(XW-33): Y = 0: GOSUB 900
13640 LPRINT ";: L3 "
13645 GOSUB 934:X = 33: Y = 0: GOSUB 900
13650 LPRINT ";: L0 U "
13655 X =-33: Y=0:GOSUB 900
13660 GOSUB 934
13665 X=0: Y=-33: GOSUB 900
13670 GOSUB 944
13675 X=33: Y=33: GOSUB 900
13680 GOSUB 934
13685 X=-(XW):Y=255:GOSUB 900
13690 X=XW:Y=0:GOSUB 900
13695 X=-(XW):Y=-255:GOSUB 900: GOSUB 944
13697 X=0:Y=268:GOSUB 900:GOSUB 934
13698 X=XW:Y=0:GOSUB 900
13700 GOSUB 944: GOSUB 964
13702 IF TY = 12 THEN 13750
```

```
13705 GOSUB 1000:GOSUB 964
13750 X = -INT((WY+24)*S-40) : Y = -63:IF TY = 12 THEN X=X+50
13753 GOSUB 900
13755 BL$="B.L. "
13760 IF TY = 3 THEN BL$ = "B.R. "
13761 IF TY = 11 THEN BL$="R.C.B. RT."
13762 IF TY = 12 THEN BL$="R.C.B. LT."
13765 LPRINT ";: S12 ";+BL$
13770 LPRINT  STR$(WY+24);CHR$(95)
13775 GOSUB 964
13777 IF TY = 12 THEN 16125
13780 LPRINT "U A 0,0"
13785 RETURN
13800 '
13805 ' ******* BLIND LEFT AND RIGHT WALL ROUTINES ****
13810 '
13815 WW = INT(12*S): WH= INT(HT * S):WY = WY   12
13820 IF TY = 16 THEN 13827
13825 GOSUB 13000 '   DRAW (WY-12) WALL CABINET ***********
13827 X=0 :Y=INT(84*S) : GOSUB 900
13830 GOSUB 934:X = WW: Y = 0: GOSUB 900
13835 X = 0: Y = -WH: GOSUB 900
13840 X = -WW: Y =0 :GOSUB 900
13845 X = 0: Y = WH: GOSUB 900
13850 X = WW: Y = -WH: GOSUB 900
13855 X = -WW: Y = 0: GOSUB 900
13860 X = WW: Y = WH: GOSUB 900
13865 GOSUB 954: GOSUB 944
13866 X=0: Y=-INT(84*S): GOSUB 900
13867 IF TY = 15 THEN RETURN
13870 IF TY = 16 THEN GOSUB 13000
13873 IF TY = 16 THEN RETURN
13874 IF TY = 12 THEN 16125
13875 X=0:Y=-INT(84*S): GOSUB 900: GOSUB 954
13880 RETURN
13900 '
13905 '     ******** TRAY STORAGE AND TOWEL DRYER ROUTINES ****
13910 '
13915 GOSUB 1000
13920 LB$="TD"
13922 X=-30 : Y=0: GOSUB 900
13925 IF TY = 9 THEN LB$= "BT"
13930 LPRINT ";: S12 ";+LB$
13935 LPRINT STR$(WY);CHR$ (95)
13940 GOSUB 964
13945 IF TY = 10 THEN 13970
13950 X = -INT(WID/2): Y = 33 : GOSUB 900
13955 GOSUB 934
13960 LPRINT ";: L3 "
13965 X = 0 : Y = 191: GOSUB 900: GOSUB 944
13970 LPRINT ";: L0 A 0,0 RU "
13975 RETURN
14000 '
14005 ' *******  MANUAL PLOT ROUTINE  *******
14010 '
14015 CLS: PRINT@73," MANUEL CONTROL COMMANDS ": PRINT
14020 PRINT " UP ARROW ................MOVE UP "
14025 PRINT " DOWN ARROW ...........MOVE DOWN "
```

```
14030 PRINT " LEFT ARROW .............MOVE LEFT "
14035 PRINT " RIGHT ARROW ..........MOVE RIGHT "
14040 PRINT " P & UP ARROW .............PEN UP "
14045 PRINT " P & DOWN ARROW .........PEN DOWN "
14050 PRINT " LEFT AND DOWN ARROW........HOME "
14055 PRINT " LEFT AND RIGHT ARROW.......TEST "
14060 PRINT " R ................RETURN TO MENU "
14065 '
14070 C$=";: R ":GOSUB 850
14075 L=PEEK(14420)
14080 IF L = 64 THEN C$ = "12 0 " :GOSUB 850
14085 IF L = 32 THEN C$ = "-12 0 " : GOSUB 850
14090 IF L = 8 THEN C$ = " 0 12 ": GOSUB 850
14095 IF L = 16 THEN C$  = " 0 -12": GOSUB 850
14100 IF L = 9 THEN C$ = "U ":GOSUB 850
14105 IF L = 17 THEN C$ = "D" : GOSUB 850
14110 IF L = 48 THEN C$ = " H ": GOSUB 850
14115 IF L = 96 THEN C$ = " T": GOSUB 850
14120 IF L <>4 THEN 14070
14150 RETURN
14200 '
14205 ' ********* RANGE ROUTINES ******
14210 '
14215 GOSUB 1000
14220 TR$= "RC"
14225 LPRINT ";: S12 ";+TR$
14230 LPRINT STR$(WY):CHR$(95)
14235 GOSUB 964
14240 LPRINT "UA 0.0"
14245 RETURN
14500 '
14510 ' **** 4 DRAWER BASE, DISHWASHER, AND COMPACTOR ****
14520 '
14540 IF TY = 7 THEN 14700
14550 IF TY = 4 THEN 14800
14560 ' *** DISHWASHER ***
14562 '
14563 WID = INT(S*24):WY = 24: GOSUB 1000
14564  WID=WID-8:GOSUB 944: X = -4:Y = 60: GOSUB 900: GOSUB 934
14566 X = WID+8: Y = 0 : GOSUB 900: GOSUB 944
14568 X = -4:Y = 4: GOSUB 900: GOSUB 934
14570 Y = 185: X = 0: GOSUB 900
14572 X = -WID: Y = 0: GOSUB 900
14574 X = 0: Y =-185: GOSUB 900
14576 X = WID: Y = 0: GOSUB 900: GOSUB 944
14578 X=-INT((WID/2)+25): Y = 165: GOSUB 900
14580 GOSUB 934:X = 50: Y=0: GOSUB 900
14582 X = 0: Y = 2: GOSUB 900
14584 X = -50: Y = 0: GOSUB 900
14586 X = 0: Y = -2: GOSUB 900
14588 GOSUB 944: X = INT(WID/2): Y = -30: GOSUB 900
14590 LPRINT ";: CC 0,12 "
14592 GOSUB 944: GOSUB 964
14594 GOTO 14947
14700 '
14701 ' *** TRASH COMPACTOR ***
14702 '
14703 CLS:PRINT " A TRASH COMPACTOR CAN BE 15 OR 24 INCHES WIDE.
      ENTER THE WIDTH YOU PREFER. ": INPUT WY: GOSUB 1000
```

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```
14704 WID = INT ( WY * S )
14706 WID = WID - 8: GOSUB 934
14708 X = WID: Y = 0 : GOSUB 900
14710 X = 0: Y = 184: GOSUB 900
14712 X = -WID: Y = 0 : GOSUB 900
14714 X = 0: Y = -184 : GOSUB 900
14716 GOSUB 944: Y = 190: X = -4 : GOSUB 900
14718 GOSUB 934: X = WID+4: Y = 0:  GOSUB 900
14720 GOSUB 944: Y = 25: X = -25: GOSUB 900
14722 LPRINT ";: CC 0,12 "
14724 GOSUB 944: X = -INT((WID/2)):Y = -50: GOSUB 900
14726 GOSUB 934: X = 50:Y = 0 :GOSUB 900
14728 X = 0: Y = 2:GOSUB 900
14730 X = -50 : Y = 0: GOSUB 900
14732 X = 0:Y = -2: GOSUB 900
14734 GOSUB 944: GOSUB 964
14736 GOTO 14947
14800 ' 4 DRAWER BASE **
14805 '
14807 GOSUB 1000
14810 WID = WID - 8 :GOSUB 934
14815 X = WID: Y = 0 : GOSUB 900
14820 X = 0: Y = 70:GOSUB 900
14825 X = -WID: Y = 0 : GOSUB 900
14830 X = 0 : Y = -70 :GOSUB 900
14835 GOSUB 944: X = 0 : Y = 74: GOSUB 900
14840 GOSUB 934: X = WID: Y = 0 : GOSUB 900
14845 X = 0 : Y = 65: GOSUB 900
14850 X = -WID: Y = 0 : GOSUB 900
14855 X = 0 : Y = -65: GOSUB 900
14860 GOSUB 944: X = 0: Y = 69: GOSUB 900
14865 GOSUB 934: X = WID: Y = 0 : GOSUB 900
14870 X = 0 : Y = 50: GOSUB 900
14875 X = -WID: Y = 0: GOSUB 900
14880 X = 0: Y = -50 : GOSUB 900
14885 GOSUB 944: X = 0: Y = 54: GOSUB 900:GOSUB 934
14890 X = WID: Y = 0 : GOSUB 900
14895 X = 0: Y = 50 : GOSUB 900
14900 X = -WID : Y = 0 : GOSUB 900
14905 X = 0 : Y = -50 : GOSUB 900
14910 GOSUB 944: X = INT(WID/2):Y = 25: GOSUB 900
14915 GOSUB 974: GOSUB 944
14920 Y = -54: X = 0 : GOSUB 900
14925 GOSUB 974: GOSUB 944
14930 Y = -61: X = 0: GOSUB 900
14935 GOSUB 974: GOSUB 944
14940 Y = -72: X = 0 :GOSUB 900
14945 GOSUB 974: GOSUB 944: GOSUB 964
14947 X=-WID: Y=-60: GOSUB 900
14950 DD$ = "B 4D"
14952 IF TY = 6 THEN DD$ = " DW "
14954 IF TY = 7 THEN DD$ = " TC "
14956 LPRINT ";: S12"; + DD$
14958 LPRINT STR$(WY);CHR$(95)
14960 GOSUB  964
14962 LPRINT "U A 0,0"
14964 RETURN
15000 '
15005 ' ****** OVEN AND STORAGE ROUTINES ****
```

```
15010 '
15015 OF = 0
15020 OW = INT(S*WY):OH=INT(84*S):GOSUB 934
15025 X=OW: Y=0: GOSUB 900: GOSUB 954
15030 X=0: Y=OH: GOSUB 900
15035 X=-OW: Y=0: GOSUB 900
15040 X=0: Y=-OH: GOSUB 900: GOSUB 944
15045 X=0: Y=33: GOSUB 900: GOSUB 934
15050 X=OW: Y=0: GOSUB 900: GOSUB 944
15055 IF TY= 20 THEN 15700 ' GO TO STORAGE ROUTINE ****
15060 IF WY<33 THEN GOTO 15500 '  GOTO ONE DOOR ROUTINE ***
15065 '
15070 ' ** 2 DOOR ROUTINE **
15075 '
15080 DW=INT((OW-14)/2)
15085 X=-4:Y=4:GOSUB 900: GOSUB 934
15090 DH=234: IF TY = 18 THEN DH=164
15095 X=0: Y=DH: GOSUB 900
15100 X=-DW: Y=0: GOSUB 900
15105 X=0: Y=-DH: GOSUB 900
15110 X=DW: Y=0: GOSUB 900: GOSUB 944
15115 X=-DW-6: Y=0:GOSUB 900: GOSUB 934
15120 X=0: Y=DH: GOSUB 900
15125 X=-DW: Y=0: GOSUB 900
15130 X=0: Y=-DH: GOSUB 900
15135 X=DW: Y=0: GOSUB 900: GOSUB 944
15140 X=-20: Y=DH-20: GOSUB 900: GOSUB 974: GOSUB 944
15145 X=46: Y=0: GOSUB 900: GOSUB 974: GOSUB 944
15150 X=-(26+DW): Y=35: GOSUB 900
15155 DH=200: IF TY=18 THEN DH = 175
15157 X=0: Y=4: GOSUB 900
15160 OD=OW-8: OF = OF + 1: GOSUB 934
15165 X=OD: Y=0: GOSUB 900
15170 X=0: Y=DH: GOSUB 900
15175 X=-OD: Y=0: GOSUB 900
15180 X=0: Y=-DH: GOSUB 900
15185 GOSUB 944
15190 GH=DH 30: GW=OD-8
15195 X=4: Y=4: GOSUB 900: GOSUB 934
15200 X=GW: Y=0: GOSUB 900
15205 X=0: Y=GH: GOSUB 900
15210 X=-GW: Y=0 :GOSUB 900
15215 X=0: Y=-GH: GOSUB 900: GOSUB 944
15220 X=INT((GW/2)-25): Y=GH-15: GOSUB 900: GOSUB 934
15225 X=50: Y=0: GOSUB 900
15230 X=0: Y=2: GOSUB 900
15235 X=-50: Y=0: GOSUB 900
15240 X=0: Y=-2: GOSUB 900
15245 GOSUB 944
15255 X=-INT(GW/2)+23: Y=60: GOSUB 900
15258 IF OF = 2 THEN 15270
15260 IF TY = 17 THEN 15270
15265 DH=125: IF OF < 2 THEN 15160
15270 GOSUB 944: GOSUB 964
15275 Y=501: X=-OW+4
15280 IF TY=18 THEN Y=546
15285 GOSUB 900
```

```
15290 '           ***** TOP CABINETS ***
15295 DH= 195: IF TY = 18 THEN DH=150
15300 GOSUB 934: X=DW: Y=0: GOSUB 900
15305 X=0: Y=DH: GOSUB 900
15310 X=-DW: Y=0: GOSUB 900
15315 X=0: Y=-DH: GOSUB 900: GOSUB 944
15318 IF WY < 33 THEN 15600
15320 X=DW+6: Y=0: GOSUB 900: GOSUB 934
15325 X=DW: Y=0: GOSUB 900
15330 X=0:Y=DH: GOSUB 900
15335 X=-DW: Y=0: GOSUB 900
15340 X=0: Y=-DH: GOSUB 900: GOSUB 944
15345 X=20: Y=20  : GOSUB 900
15350 GOSUB 974: GOSUB 944
15355 X=-46: Y=0: GOSUB 900
15360 GOSUB 974: GOSUB 944
15365 GOSUB 964
15380 GOSUB 964
15385 GOTO 15850
15500 '
15505 ' ****  ONE DOOR OVEN CABINET ROUTINE  ****
15510 '
15515 DW=OW-8: DH=234
15520 IF TY = 18 THEN DH = 164
15525 X=-4: Y=4: GOSUB 900: GOSUB 934
15530 X=0:Y=DH: GOSUB 900
15535 X=-DW: Y=0: GOSUB 900
15540 X=0: Y=-DH: GOSUB 900
15545 X=DW: Y=0: GOSUB 900: GOSUB 944 ' FINISH LOWER DOOR
15550 CLS:PRINT "DO YOU WANT THE KNOBS ON THE LEFT (L) OR RIGHT
      (R) OF THE CABINET DOORS ? "
15555 K$ = INKEY$: IF K$ = "" THEN 15555
15557 IF TY = 20 THEN 15730
15560 IF K$ = "R" THEN 15575
15565 IF K$ = "L" THEN 15585
15570 GOTO 15555
15575 X=-20: Y=DH-20: GOSUB 900: GOSUB 974
15580 GOSUB 944: X=-(DW-20): Y=35: GOSUB 900: GOSUB 934:
      GOTO 15155
15585 X=-(DW-20): Y=DH-20: GOSUB 900: GOSUB 974
15590 GOSUB 944: X=-20: Y=35: GOSUB 900: GOSUB 934
15595 GOTO 15155 '  ** GO DRAW OVEN DOORS **
15600 IF K$="R" THEN X=DW-20
15605 IF K$="L" THEN X=20
15610 Y=20: GOSUB 900: GOSUB 974: GOSUB 944
15615 IF K$ = "R" THEN X=20
15620 IF K$ = "L" THEN X=DW-20
15625 Y=DH-5: GOSUB 900
15630  GOSUB 944: GOSUB 964
15635 GOTO 15850
15700 '
15705 ' *** STORAGE ROUTINE ***
15710 '
15715 DW = OW - 8: DH = 500
15720 GOTO 15525 ' GO DRAW LOWER DOOR *****
15725 ' *
15730 IF K$ = "R" THEN 15745
15735 IF K$ = "L" THEN 15751
```

```
15740 GOTO 15555
15745 X=-20: Y=400: GOSUB 900: GOSUB 974: GOSUB 944
15750 X=-DW+20: Y=106: GOSUB 900: GOSUB 934: GOTO 15755
15751 X=-DW+20: Y=400: GOSUB 900: GOSUB 974: GOSUB 944
15753 X=-20: Y=106: GOSUB 900: GOSUB 934
15755 X=DW: Y=0 : GOSUB 900
15760 X=0: Y=153: GOSUB 900
15765 X=-DW: Y=0: GOSUB 900
15770 X=0: Y=-153: GOSUB 900
15775 IF K$ = "L" THEN 15790
15780 X=DW-20: Y=20: GOSUB 944: GOSUB 900
15785 GOSUB 974: GOSUB 944: X=20: Y=152: GOSUB 900: GOTO 15800
15790 X=20: Y=20: GOSUB 944: GOSUB 900
15795 GOSUB 974: GOSUB 944: X=DW-20: Y=152: GOSUB 900
15800 GOSUB 944: GOSUB 964
15849 '
15850 ' OVEN AND STORAGE LABEL ROUTINE
15855 '
15860 X=-OW: Y=-65: GOSUB 900
15865 LB$ = " O."
15870 IF TY =18 THEN LB$ = " DBL.O."
15875 IF TY = 20 THEN LB$ = " ST."
15880 LPRINT ";: S12";+LB$
15885 LPRINT STR$(WY):CHR$(95)
15890 GOSUB 964
15895 LPRINT "U A 0,0"
15900 RETURN
16000 '
16005 ' *** WALL CABINET WITH HOOD  ***
16010 '
16015 HT=12: GOSUB 13015
16020 GOSUB 944: X=0: Y = -YW-5: GOSUB 900
16025 GOSUB 934
16030 X=0: Y=-60: GOSUB 900
16035 X=-XW: Y=0: GOSUB 900
16040 X=0: Y=60: GOSUB 900
16045 X=30: Y=-35: GOSUB 900
16050 X=0: Y=-25: GOSUB 900
16055 X=0: Y=25 : GOSUB 900
16060 X=XW-60: Y=0: GOSUB 900
16065 X=0: Y=-25: GOSUB 900
16070 X=0: Y=25: GOSUB 900
16075 X=30: Y=35: GOSUB 900: GOSUB 944: GOSUB 964
16078 GOSUB 13328
16085 RETURN
16100 '
16105 ' **** ROTATING CORNER BASE CABINETS ****
16110 '
16115 WY=WY-24
16120 IF TY = 12 THEN 13540
16125 XW=INT(12*S): XH=288: GOSUB 934
16130 X=XW: Y=0: GOSUB 900
16135 GOSUB 954
16140 X=0: Y=XH: GOSUB 900
16145 X=-XW: Y=0 : GOSUB 900
16150 X=0: Y=-XH: GOSUB 900: GOSUB 944
16155 X=0: Y=300: GOSUB 900: GOSUB 934
```

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16160 X=XW: Y=0: GOSUB 900: GOSUB 944: GOSUB 964
16165 X=0: Y=33: GOSUB 900: GOSUB 934
16170 X=-XW: Y=0: GOSUB 900: GOSUB 944
16175 X=4: Y=4: GOSUB 900: GOSUB 934
16180 XW=XW-8: XH=XH-41
16185 X=XW: Y= 0: GOSUB 900
16190 X=0: Y=XH: GOSUB 900
16195 X=-XW: Y=0: GOSUB 900
16200 X=0: Y=-XH: GOSUB 900: GOSUB 944
16205 X=20: Y=195   : IF TY = 12 THEN X = XW-20
16210 GOSUB 900: GOSUB 974: GOSUB 944: GOSUB 964
16215 IF TY = 12 THEN RETURN
16220 GOTO 13540
16300 '
16305 ' **** DESK ROUTINE ****
16310 '
16315 DW=288: DH=INT(WY*S)
16320 X=0 :Y=DW: GOSUB 934 : GOSUB 900
16325 X=DH: Y=0: GOSUB 900
16326 GOSUB 944: X=0:Y=12: GOSUB 900: GOSUB 934: X=-DH: Y=0:
      GOSUB 900: GOSUB 944:X=DH: Y=-12:GOSUB 900: GOSUB 934
16330 X=0: Y=-62: GOSUB 900
16335 X=-DH: Y=0: GOSUB 900: GOSUB 944
16340 X=6: Y=6: GOSUB 900: GOSUB 934
16345 DR=DH-12: DU=50
16350 X=0: Y=DU: GOSUB 900
16355 X=DR: Y=0:GOSUB 900
16360 X=0: Y=-DU: GOSUB 900
16365 X=-DR: Y=0: GOSUB 900: GOSUB 944
16370 X=INT(DR/2): Y=25: GOSUB 900
16375 GOSUB 974: GOSUB 944
16380 X=-INT(DR/2): Y=-31: GOSUB 900: GOSUB 934
16385 X=0: Y=-(DW-62): GOSUB 900
16390 X=-6: Y=0 : GOSUB 900: GOSUB 944
16395 X=DH-8: Y=0: GOSUB 900: GOSUB 934
16400 X=0: Y=DW-62: GOSUB 900
16405 X=6: Y=0: GOSUB 900
16410 X=0: Y=-(DW-62): GOSUB 900: GOSUB 954
16415 X=-6: Y=0: GOSUB 900: GOSUB 944
16420 X=-(DH-20): Y=-63: GOSUB 900
16425 BL$=" DESK"
16430 LPRINT" ;: S12";+BL$
16435 LPRINT STR$(WY);CHR$(95)
16440 GOSUB 944: GOSUB 964
16445 RETURN
16500 '
16505 ' ****  FURRED CEILING  ****
16510 '
16515 GOSUB 944
16517 LPRINT" ;: A H 100,400 R "
16520 X = 0: Y = 712
16522 XS = INT ( XX * S )
16525 GOSUB 900: GOSUB 934
16530 X = XS: Y = 0: GOSUB 900
16535 GOSUB 944: GOSUB 964
16540 RETURN
```

```
100  REM * MACHINE SHOP CALC *
110  REM *      F. MULLEN     *
120  REM *      TAIU 1984     *

130  HOME
140  PRINT  TAB( 11)"MACHINE SHOP CALC"
150  PRINT : PRINT : PRINT
160  PRINT : PRINT "(1) LATHE SPINDLE RPM"
170  PRINT : PRINT "(2) THREAD CUTTING"
180  PRINT : PRINT "(3) TAPER TURNING"
190  PRINT : PRINT "(4) SPUR GEARS"
200  PRINT : PRINT "(5) QUIT"
210  PRINT : PRINT : PRINT : PRINT
220  INPUT "ENTER # OF SELECTION: ";A$
230  A =  VAL (A$)
240  IF A < 1 OR A > 5 THEN 130
250  IF A = 5 THEN  HOME : END
260  ON A GOTO 300,500,800,1100

300  REM LATHE SPINDLE RPM
310  HOME
320  PRINT  TAB( 10)"LATHE SPINDLE RPM"
330  PRINT : PRINT
340  PRINT  TAB( 11)"      C.S. X 12"
350  PRINT  TAB( 11)"RPM = ----------"
360  PRINT  TAB( 11)"      DIA X PI"
370  PRINT : PRINT
380  PRINT "ENTER"
390  PRINT : PRINT : INPUT "CUTTING SPEED (FPM): ";CS
400  PRINT : INPUT "DIA. OF WORKPIECE: ";DIA
410  RPM = (CS * 12) / (DIA * 3.1416)
420  RPM =  INT (RPM + .5)
430  PRINT : PRINT : PRINT
440  PRINT "SET SPINDLE --> ";RPM;" RPM"
450  GOSUB 1700
460  GOTO 300

500  REM THREAD CUTTING
510  HOME
520  PRINT  TAB( 14)"THREAD CUTTING"
530  PRINT : PRINT : PRINT
540  PRINT "ENTER"
550  PRINT : INPUT "MAJOR DIAMETER: ";MD
560  PRINT : INPUT "THREADS PER INCH: ";TPI
570  P = 1 / TPI
580  TDS = MD - P
590  DT = .61343 * P
600  MND = MD - (2 * DT)
610  P = ( INT (P * 1000 + .5)) / 1000
620  TDS = ( INT (TDS * 1000 + .5)) / 1000
```

```
630  DT = ( INT (DT * 1000 + .5)) / 1000
640  MND = ( INT (MND * 1000 + .5)) / 1000
650  PRINT : PRINT
660  PRINT "PITCH ------------> ";P;" INCHES"
670  PRINT : PRINT "TAP DRILL SIZE --> ";TDS;" INCHES"
680  PRINT : PRINT "THREAD DEPTH ----> ";DT;" INCHES"
690  PRINT : PRINT "MINOR DIAMETER --> ";MND;" INCHES"
700  GOSUB 1700
710  GOTO 500

800  REM TAPER TURNING
810  HOME
820  PRINT  TAB( 13)"TAPER TURNING"
830  PRINT : PRINT
840  PRINT "ENTER"
850  PRINT : PRINT : INPUT "LENGTH OF TAPER: ";LT
860  PRINT : INPUT "LENGTH OF WORKPIECE: ";LW
870  IF LT > LW THEN  PRINT : PRINT 'NOT POSSIBLE" CHR$ (7)
     : FOR Z = 1 TO 1000: NEXT : GOTO 800
880  PRINT : INPUT "LARGE DIAMETER: ";LD
890  PRINT : INPUT "SMALL DIAMETER: ";SD
900  IF SD > LD THEN  PRINT : PRINT "NOT POSSIBLE" CHR$ (7)
     : FOR Z = 1 TO 1000: NEXT : GOTO 800
910  TN = ((LD - SD) * .5) / LT
920  DG =  ATN (TN) * 57.2958
930  SC =  INT ((DG -  INT (DG)) * 60)
940  PRINT : PRINT
950  PRINT : PRINT "COMPOUND REST ------> "; INT (DG);
     " DEG. ";SC;" SEC."
960  DG = DG * 2
970  SC =  INT ((DG -  INT (DG)) * 60)
980  PRINT : PRINT "TAPER ATTACHMENT ---> "; INT (DG);
     " DEG. ";SC;" SEC."
990  LT = LT / 12:LW = LW / 12
1000  RT = (LD - SD) / LT
1010  SO = (RT * LW) / 2
1020  SO = ( INT (SO * 1000 + .5)) / 1000
1030  PRINT : PRINT "TAILSTK SETOVER ----> ";SO;" INCHES"
1040  GOSUB 1700
1050  GOTO 800

1100  REM SPUR GEARS
1110  HOME
1120  PRINT  TAB( 15)"SPUR GEARS"
1130  PRINT : PRINT : PRINT
1140  PRINT : PRINT : PRINT
1150  PRINT "(1) ONE GEAR"
1160  PRINT : PRINT "(2) GEAR & PINION"
1170  PRINT : PRINT
1180  PRINT : PRINT : INPUT "ENTER # OF SELECTION: ";A$
```

```
1190  A =  VAL (A$)
1200  IF A < 1 OR A > 2 THEN 1100
1210  ON A GOTO 1220,1390
1220  HOME
1230  PRINT  TAB( 15)"SPUR GEARS"
1240  PRINT : PRINT : PRINT
1250  PRINT "ENTER"
1260  PRINT : INPUT "NUMBER OF TEETH: ";NT
1270  PRINT : INPUT "DIAMETRAL PITCH: ";DP
1280  PD = NT / DP
1290  PD =  INT (PD * 1000 + .5) / 1000
1300  OD = (NT + 2) / DP
1310  OD =  INT (OD * 1000 + .5) / 1000
1320  WD = 2.157 / DP
1330  WD =  INT (WD * 1000 + .5) / 1000
1340  PRINT : PRINT : PRINT "PITCH DIA. -----> ";PD;" INCHES"
1350  PRINT : PRINT "OUTSIDE DIA. ---> ";OD;" INCHES"
1360  PRINT : PRINT "WHOLE DEPTH ----> ";WD;" INCHES"
1370  GOSUB 1700
1380  GOTO 1100
1390  HOME
1400  PRINT  TAB( 15)"SPUR GEARS"
1410  PRINT : PRINT
1420  PRINT "ENTER"
1430  PRINT : INPUT "NO OF TEETH (PINION): ";NP
1440  INPUT "                    (GEAR): ";NG
1450  IF NP > NG THEN  PRINT : PRINT "NOT POSSIBLE" CHR$ (7)
      : FOR Z = 1 TO 1000: NEXT : GOTO 1390
1460  PRINT : INPUT "DIAMETRAL PITCH: ";DP
1470  PP = NP / DP
1480  PP =  INT (PP * 1000 + .5) / 1000
1490  PG = NG / DP
1500  PG =  INT (PG * 1000 + .5) / 1000
1510  OP = (NP + 2) / DP
1520  OP =  INT (OP * 1000 + .5) / 1000
1530  OG = (NG + 2) / DP
1540  OG =  INT (OG * 1000 + .5) / 1000
1550  WD = 2.157 / DP
1560  WD =  INT (WD * 1000 + .5) / 1000
1570  CD = (PP + PG) / 2
1580  CD =  INT (CD * 1000 + .5) / 1000
1590  R =  INT ((NG / NP) * 100 + .5) / 100
1600  PRINT : PRINT "PITCH DIA. (PINION) ----> ";PP;" INCHES"
1610  PRINT "                   (GEAR) ----> ";PG;" INCHES"
1620  PRINT : PRINT "OUTSIDE DIA. (PINION) --> ";OP;" INCHES"
1630  PRINT "                     (GEAR) --> ";OG;" INCHES"
1640  PRINT : PRINT "WHOLE DEPTH ------------> ";WD;" INCHES"
1650  PRINT : PRINT "RATIO (GEAR/PINION) ----> ";R;":1"
1660  PRINT : PRINT "CENTER DISTANCE --------> ";CD;" INCHES"
1670  GOSUB 1700
```

```
1680  GOTO 1100

1700  REM ANOTHER PROBLEM ?
1710  PRINT : PRINT : INPUT "ANOTHER PROBLEM (Y/N)  ";A$
1720  IF  LEFT$ (A$,1) = "N" THEN 100
1730  RETURN
```

```
100  REM * LATHE SPINDLE RPM *
110  REM *      F. MULLEN      *
120  REM *      TAIU 1984      *

130  HOME
140  PRINT  TAB( 10)"LATHE SPINDLE RPM"
150  PRINT : PRINT
160  PRINT  TAB( 11)"      C.S. X 12"
170  PRINT  TAB( 11)"RPM = ---------"
180  PRINT  TAB( 11)"      DIA X PI"
190  PRINT : PRINT
200  PRINT "ENTER:"
210  PRINT : PRINT : INPUT "CUTTING SPEED (FPM): ";CS
220  PRINT : INPUT "DIA. OF WORKPIECE (IN.): ";DIA
230  RPM = (CS * 12) / (DIA * 3.1416)
240  RPM =  INT (RPM + .5)
250  PRINT : PRINT : PRINT
260  PRINT "SET SPINDLE --> ";RPM;" RPM"
270  PRINT : PRINT : INPUT "ANOTHER PROBLEM (Y/N) ";A$
280  IF  LEFT$ (A$,1) = "N" THEN  HOME : END
290  GOTO 130
```

```
100  REM * THREAD CUTTING *
110  REM *    F. MULLEN    *
120  REM *    TAIU 1984    *

130  HOME
140  PRINT  TAB( 14)"THREAD CUTTING"
150  PRINT : PRINT : PRINT
160  PRINT "ENTER DECIMAL VALUES:"
170  PRINT : PRINT : INPUT "MAJOR DIAMETER (IN.): ";MD
180  PRINT : INPUT "THREADS PER INCH: ";TPI
190  P = 1 / TPI
200  TDS = MD - P
210  DT = .61343 * P
220  MND = MD - (2 * DT)
230  P = ( INT (P * 1000 + .5)) / 1000
240  TDS = ( INT (TDS * 1000 + .5)) / 1000
250  DT = ( INT (DT * 1000 + .5)) / 1000
260  MND = ( INT (MND * 1000 + .5)) / 1000
270  PRINT : PRINT
280  PRINT "PITCH -----------> ";P;" INCHES"
290  PRINT : PRINT "TAP DRILL SIZE --> ";TDS;" INCHES"
300  PRINT : PRINT "THREAD DEPTH ----> ";DT;" INCHES"
310  PRINT : PRINT "MINOR DIAMETER --> ";MND;" INCHES"
320  PRINT : PRINT : INPUT "ANOTHER PROBLEM (Y/N) ";A$
330  IF  LEFT$ (A$,1) = "N" THEN  HOME : END
340  GOTO 130
```

```
100  REM * TAPER TURNING *
110  REM *   F. MULLEN   *
120  REM *   TAIU 1984   *

130  HOME
140  PRINT  TAB( 13)"TAPER TURNING"
150  PRINT : PRINT
160  PRINT "ENTER AS DECIMAL VALUES:"
170  PRINT : PRINT : INPUT "LENGTH OF TAPER: ";LT
180  PRINT : INPUT "LENGTH OF WORKPIECE: ";LW
190  IF LT > LW THEN  PRINT : PRINT "NOT POSSIBLE" CHR$ (7)
     : FOR Z = 1 TO 1000: NEXT : GOTO 130
200  PRINT : INPUT "LARGE DIAMETER: ";LD
210  PRINT : INPUT "SMALL DIAMETER: ";SD
220  IF SD > LD THEN  PRINT : PRINT "NOT POSSIBLE" CHR$ (7)
     : FOR Z = 1 TO 1000: NEXT : GOTO 130
230  TN = ((LD - SD) * .5) / LT
240  DG =  ATN (TN) * 57.2958
250  SC =  INT ((DG -  INT (DG)) * 60)
260  PRINT : PRINT
270  PRINT : PRINT "COMPOUND REST ------> "; INT (DG);
     " DEG. ";SC;" SEC."
280  DG = DG * 2
290  SC =  INT ((DG -  INT (DG)) * 60)
300  PRINT : PRINT "TAPER ATTACHMENT ---> "; INT (DG);
     " DEG. ";SC;" SEC."
310  LT = LT / 12:LW = LW / 12
320  RT = (LD - SD) / LT
330  SO = (RT * LW) / 2
340  SO = ( INT (SO * 1000 + .5)) / 1000
350  PRINT : PRINT "TAILSTK SETOVER ----> ";SO;" INCHES"
360  PRINT : PRINT : INPUT "ANOTHER PROBLEM (Y/N) ";A$
370  IF  LEFT$ (A$,1) = "N" THEN  HOME : END
380  GOTO 130
```

```
100  REM * SPUR GEARS *
110  REM *  F. MULLEN *
120  REM *  TAIU 1984 *

130  HOME
140  PRINT  TAB( 15)"SPUR GEARS"
150  PRINT : PRINT : PRINT
160  PRINT "GEAR MENU"
170  PRINT : PRINT
180  PRINT "(1) ONE GEAR"
190  PRINT : PRINT "(2) GEAR & PINION"
200  PRINT : PRINT
210  PRINT : PRINT : INPUT "ENTER # OF SELECTION: ";A$
220  A =  VAL (A$)
230  IF A < 1 OR A > 2 THEN 1100
240  ON A GOTO 250,500

250  REM ONE GEAR
260  HOME
270  PRINT  TAB( 15)"SINGLE GEAR"
280  PRINT : PRINT : PRINT
290  PRINT "ENTER"
300  PRINT : INPUT "NUMBER OF TEETH: ";NT
310  PRINT : INPUT "DIAMETRAL PITCH: ";DP
320  PD = NT / DP
330  PD =  INT (PD * 1000 + .5) / 1000
340  OD = (NT + 2) / DP
350  OD =  INT (OD * 1000 + .5) / 1000
360  WD = 2.157 / DP
370  WD =  INT (WD * 1000 + .5) / 1000
380  PRINT : PRINT : PRINT "PITCH DIA. -----> ";PD;" INCHES"
390  PRINT : PRINT "OUTSIDE DIA. ---> ";OD;" INCHES"
400  PRINT : PRINT "WHOLE DEPTH ----> ";WD;" INCHES"
410  GOTO 790

500  REM GEAR & PINION
510  HOME
520  PRINT  TAB( 13)"GEAR AND PINION"
530  PRINT : PRINT
540  PRINT "ENTER"
550  PRINT : INPUT "NO OF TEETH (PINION): ";NP
560  INPUT "                (GEAR): ";NG
570  IF NP > NG THEN  PRINT : PRINT "NOT POSSIBLE" CHR$ (7)
     : FOR Z = 1 TO 1000: NEXT : GOTO 500
580  PRINT : INPUT "DIAMETRAL PITCH: ";DP
590  PP = NP / DP
600  PP =  INT (PP * 1000 + .5) / 1000
610  PG = NG / DP
620  PG =  INT (PG * 1000 + .5) / 1000
630  OP = (NP + 2) / DP
```

```
640  OP =  INT (OP * 1000 + .5) / 1000
650  OG = (NG + 2) / DP
660  OG =  INT (OG * 1000 + .5) / 1000
670  WD = 2.157 / DP
680  WD =  INT (WD * 1000 + .5) / 1000
690  CD = (PP + PG) / 2
700  CD =  INT (CD * 1000 + .5) / 1000
710  R =  INT ((NG / NP) * 100 + .5) / 100
720  PRINT : PRINT "PITCH DIA. (PINION) ----> ";PP;" INCHES"
730  PRINT "             (GEAR) ----> ";PG;" INCHES"
740  PRINT : PRINT "OUTSIDE DIA. (PINION) --> ";OP;" INCHES"
750  PRINT "               (GEAR) --> ";OG;" INCHES"
760  PRINT : PRINT "WHOLE DEPTH ------------> ";WD;" INCHES"
770  PRINT : PRINT "RATIO (GEAR/PINION) ----> ";R;":1"
780  PRINT : PRINT "CENTER DISTANCE --------> ";CD;" INCHES"
790  PRINT : PRINT : INPUT "ANOTHER PROBLEM (Y/N) ";A$
800  IF  LEFT$ (A$,1) = "N" THEN  HOME : END
810  GOTO 130
```

APPLYCATIONS

This is a set of applycation programs. That is programs meant to be used to perform a certain task. The first program of this group is "ROOF". This program will estimate the cost, joist, rafters, and the plywood decking for a roof. With prices from a catalog it could easily be updated to calculate shingles, and paper. The program prints out a cutting chart, a buying chart, and a total cost. For instance, say you wanted to build a roof with a 24′ 0" top plate at the eave, and a 24′ 0" span. With a 24" overhang at the eave and a 12" overhang of the rake. That has 6" rise per foot of run, a 6" thick ridgeboard, a 2.5" thick 5.5" wide rafter, and a 16" spacing between the rafters and between the joist. With a price of $184.00 per 1000 board feet, and $12.00 each for 4′ by 8′ plywood. This program could give you a cutting chart for the joist, rafters, and plywood. Plus a price list for the same, and a total cost. The number of squares in the roof are also already computed in case you want to add shingles to the program.

Here is a sample run and listing of the program.

```
1310  IF P2 <  > (RL + (.5 * RT))
      / 2 THEN P2 = P2 + 1
1330  REM
1340  REM FIND THE # OF
1350  REM PLYWOOD SHEETS
1360  REM NEEDED TIMES 4
1365  REM BECAUSE PLYWOOD
1366  REM DIVIDED INTO 4TH'S
1367  REM IS STILL USEABLE.
1370  REM
1380 NP = P1 * P2 * 2
1381 NP =  INT (NP / 4)
1382  IF NP <  >  INT (P1 * P2 /
     2) THEN NP = NP + 1
1384  REM
1385  REM FIND THEIR WASTE
1386  REM
1390 WP = ((P1 * P2 * 2 * 8) - (S
     Q * 100)) / (P1 * P2 * 2 * 8
     )
1391 WP =  INT (WP * 10000 + .5) /
     100
1394  REM
1395  REM FIND THE COST OF
1396  REM THE PLYWOOD.
1400 PC = NP * CP
3050  REM
3060  REM OUTPUT RESULTS
3070  REM
3075  HOME : VTAB 6
3080  PRINT  TAB( 5)"DO YOU WANT
     THE OUTPUT TO GO"
3090  PRINT "TO THE PRINTER (Y/N)
     ?";: GET X$
3100  IF X$ = "Y" GOTO 3140
3110  IF X$ = "N" GOTO 3180
3120  PRINT : PRINT : PRINT : PRINT
      TAB( 5)"ILLEGAL ENTRY, TRY
     AGAIN.": PRINT : PRINT : PRINT

3130  GOTO 3080
3140  PRINT  TAB( 5)"SET THE PRIN
     TER TO THE TOP OF"
3142  PRINT "PRESS <RETURN> TO CO
     NTINUE";: INPUT A$
3150 D$ =  CHR$ (4)
3160  PRINT D$;"PR#1"
3170  PRINT : PRINT : PRINT
3180  IF X$ = "N" THEN  HOME : VTAB
     4
3190  HTAB 12: PRINT "CUTTING CHA
     RT": PRINT
3200  PRINT "ITEM";: HTAB 16: PRINT
     "QUANTITY";: HTAB 25: PRINT
     "LENGTH"
3210  PRINT "RAFTERS";: HTAB 16: PRINT
     NR;: HTAB 25: PRINT R1;" FT.
      ";R2;" IN."
```

```
3220  PRINT "JOIST";: HTAB 16: PRINT
     NJ;: HTAB 25: PRINT J1;" FT.
      ";J2;" IN."
3230  PRINT "RIDGEBOARDS";: HTAB
     16: PRINT "1";: HTAB 25: PRINT
     B1;" FT. ";B2;" IN."
3240  PRINT "FASCIAL BOARDS";: HTAB
     16: PRINT "2";: HTAB 25: PRINT
     B1;" FT. ";B2;" IN."
3250  PRINT "PLYWOOD SHEETS";: HTAB
     16: PRINT NP;: HTAB 25: PRINT
     "8 FT. BY 4 FT."
3260  PRINT : PRINT : PRINT
3270  HTAB 6: PRINT "MATERIAL AND
      COST CHART": PRINT
3280  PRINT "ITEM";: HTAB 16: PRINT
     "QUANTITY";: HTAB 25: PRINT
     "LENGTH";: HTAB 32: PRINT "C
     OST"
3290  PRINT "RAFTERS";: HTAB 16: PRINT
     NR;: HTAB 25: PRINT R3;" FT.
     ";: HTAB 32: PRINT "$";CR
3300  PRINT "JOIST";: HTAB 16: PRINT
     NJ;: HTAB 25: PRINT J3;" FT.
     ";: HTAB 32: PRINT "$";CJ
3310  PRINT "RIDGEBOARDS";: HTAB
     16: PRINT "1";: HTAB 25: PRINT
     B3;" FT.";: HTAB 32: PRINT "
     $"; INT (CB / 3 * 100 + 1) /
     100
3320  PRINT "FASCIAL BOARDS";: HTAB
     16: PRINT "2";: HTAB 25: PRINT
     B3;" FT.";: HTAB 32: PRINT "
     $"; INT (CB / 3 * 100) / 100
      * 2
3330  PRINT "PLYWOOD SHEETS";: HTAB
     16: PRINT NP;: HTAB 25: PRINT
     "4'X8'";: HTAB 32: PRINT "$"
     ;PC
3332 TC = CR + CJ + CB + PC
3335  PRINT : PRINT "TOTAL COST:
     ";TC
3340  IF X$ = "Y" THEN  PRINT  CHR$
     (12): PRINT  CHR$ (4);"PR#0"

3350  END

]
```

```
RUN ROOF


     THIS PROGRAM WILL HELP YOU
ESTIMATE THE COST AND MATERIAL OF
A GIVEN ROOF.
          DEMONSTRATION PROGRAM
         FOR EDUCATIONAL USE ONLY



     PRESS <RETURN> TO CONTINUE?



     TO RUN THIS PROGRAM YOU NEED
TO KNOW THE LENGTH OF THE TOP PLATE
AT THE EAVE, THE SPAN OF THE ROOF,
THE OVERHANG OF THE RAKE, THE RISE
PER FOOT OF RUN, THE ACTUAL SIZE OF
THE RIDGEBOARD, THE SIZE OF THE
RAFTERS(THICKNESS AND WIDTH), THE
SPACING OF THE RAFTERS, THE SPACING
OF THE JOIST, AND THE PRICE PER 1000
BOARD FEET.



     DO YOU HAVE THESE (Y/N)?


     WHAT IS THE LENGTH OF THE TOP
PLATE, AT THE EAVE, IN FEET AND INCHES
                    FEET?24
                    INCHES?0



     WHAT IS THE SPAN OF THE ROOF IN
FEET AND INCHES
                    FEET?24
                    INCHES?0



     WHAT IS THE OVERHANG OF THE EAVE
IN INCHES?24



     WHAT IS THE OVERHANG OF THE RAKE
IN INCHES?12



     WHAT IS THE RISE PER FOOT OF
RUN, IN INCHES?6
```

```
    WHAT IS THE ACTUAL SIZE OF THE
RIDGEBOARD THICKNESS IN INCHES?6


    WHAT IS THE SIZE OF THE RAFTER
IN INCHES
                        THICKNESS?2.5
                        WIDTH?5.5


    WHAT IS THE SPACING OF THE
RAFTERS IN INCHES?16


    WHAT IS THE SPACING OF THE JOIST
IN INCHES?16


    WHAT IS THE PRICE PER 1000 BOARD
FEET?184


    WHAT IS THE COST OF A 4' BY 8'
SHEET OF PLYWOOD?12
    DO YOU WANT THE OUTPUT TO GO
TO THE PRINTER (Y/N)?SET THE PRINTER TO THE TOP OF


PRESS <RETURN> TO CONTINUE?
```

CUTTING CHART

ITEM	QUANTITY	LENGTH
RAFTERS	38	15 FT. 7.22 IN.
JOIST	19	22 FT. 10.99 IN.
RIDGEBOARDS	1	26 FT. 0 IN.
FASCIAL BOARDS	2	26 FT. 0 IN.
PLYWOOD SHEETS	28	8 FT. BY 4 FT.

MATERIAL AND COST CHART

ITEM	QUANTITY	LENGTH	COST
RAFTERS	38	16 FT.	$111.87
JOIST	19	24 FT.	$83.9
RIDGEBOARDS	1	26 FT.	$4.79
FASCIAL BOARDS	2	26 FT.	$9.56
PLYWOOD SHEETS	28	4'X8'	$336

TOTAL COST: 546.12

```
]LIST

10  REM THIS IS A PROGRAM
20  REM TO ESTIMATE THE COST
30  REM AND MATERIAL OF A
40  REM ROOFING PROJECT
50  REM
55  HOME : PRINT : PRINT : PRINT

60  PRINT  TAB( 5)"THIS PROGRAM W
     ILL HELP YOU"
70  PRINT "ESTIMATE THE COST AND
     MATERIAL OF"
80  PRINT "A GIVEN ROOF."
81  VTAB 10
82  INVERSE
83  HTAB 10: PRINT "DEMONSTRATION
      PROGRAM"
84  HTAB 9: PRINT "FOR EDUCATIONA
     L USE ONLY"
85  NORMAL
86  PRINT : PRINT : PRINT
87  PRINT  TAB( 5)"PRESS <RETURN>
      TO CONTINUE";: INPUT A$
90  HOME : PRINT : PRINT : PRINT

95  REM
100  PRINT  TAB( 5)"TO RUN THIS P
     ROGRAM YOU NEED"
110  PRINT "TO KNOW THE LENGTH OF
      THE TOP PLATE"
120  PRINT "AT THE EAVE, THE SPAN
      OF THE ROOF,"
130  PRINT "THE OVERHANG OF THE R
     AKE, THE RISE"
140  PRINT "PER FOOT OF RUN, THE
     ACTUAL SIZE OF"
150  PRINT "THE RIDGEBOARD, THE S
     IZE OF THE"
160  PRINT "RAFTERS(THICKNESS AND
      WIDTH), THE"
170  PRINT "SPACING OF THE RAFTER
     S, THE SPACING"
180  PRINT "OF THE JOIST, AND THE
      PRICE PER 1000"
190  PRINT "BOARD FEET."
200  PRINT : PRINT : PRINT
210  PRINT  TAB( 5)"DO YOU HAVE T
     HESE (Y/N)?";
220  GET X$
230  PRINT : PRINT : PRINT
240  IF X$ = "Y" GOTO 280
250  IF X$ = "N" THEN  END
260  PRINT  TAB( 5)"ILLEGAL ENTRY
     , TRY AGAIN.": PRINT : PRINT
     : PRINT
```

```
270  GOTO 210
280  REM
290  REM  ENTER THE DATA
300  REM
310  PRINT  TAB( 5)"WHAT IS THE L
     ENGTH OF THE TOP"
320  PRINT "PLATE, AT THE EAVE, I
     N FEET AND INCHES"
321  PRINT  TAB( 20)"FEET";: INPUT
     F
322  PRINT  TAB( 20)"INCHES";: INPUT
     I
323 I = I / 12
324 LP = F + I
330  PRINT : PRINT : PRINT
340  PRINT  TAB( 5)"WHAT IS THE S
     PAN OF THE ROOF IN"
341  PRINT "FEET AND INCHES"
342  PRINT  TAB( 20)"FEET";: INPUT
     F
343  PRINT  TAB( 20)"INCHES";: INPUT
     I
344 I = (I - 7) / 12
345 LS = F + I
350  PRINT : PRINT : PRINT
360  PRINT  TAB( 5)"WHAT IS THE O
     VERHANG OF THE EAVE"
361  PRINT "IN INCHES";: INPUT I
362 I = (I + 3.5) / 12
363 OE = I
370  PRINT : PRINT : PRINT
380  PRINT  TAB( 5)"WHAT IS THE O
     VERHANG OF THE RAKE"
381  PRINT "IN INCHES";: INPUT I
382 I = I / 12
383 OV = I
390  PRINT : PRINT : PRINT
400  PRINT  TAB( 5)"WHAT IS THE R
     ISE PER FOOT OF"
410  PRINT "RUN, IN INCHES";: INPUT
     I
420 I = I / 12
430 RI = I
440  PRINT : PRINT : PRINT
450  PRINT  TAB( 5)"WHAT IS THE A
     CTUAL SIZE OF THE"
460  PRINT "RIDGEBOARD THICKNESS
     IN INCHES";: INPUT I
470 I = I / 12
480 RT = I
485 LS = LS - RT
490  PRINT : PRINT : PRINT
500  PRINT  TAB( 5)"WHAT IS THE S
     IZE OF THE RAFTER"
501  PRINT "IN INCHES"
502  PRINT  TAB( 20)"THICKNESS";:
      INPUT TR
503 TR = TR / 12
```

```
504  PRINT  TAB( 20)"WIDTH";: INPUT
     WR
505 WR = WR / 12
580  PRINT : PRINT : PRINT
590  PRINT  TAB( 5)"WHAT IS THE S
     PACING OF THE"
600  PRINT "RAFTERS IN INCHES";: INPUT
     I
610 I = I / 12
620 SR = I
630  PRINT : PRINT : PRINT
640  PRINT  TAB( 5)"WHAT IS THE S
     PACING OF THE JOIST"
650  PRINT "IN INCHES";: INPUT I
660 I = I / 12
670 SJ = I
680  PRINT : PRINT : PRINT
690  PRINT  TAB( 5)"WHAT IS THE P
     RICE PER 1000 BOARD"
700  PRINT "FEET";: INPUT C
705 C = C / 1000
710  PRINT : PRINT : PRINT
711  PRINT  TAB( 5)"WHAT IS THE C
     OST OF A 4' BY 8'"
712  PRINT "SHEET OF PLYWOOD";: INPUT
     CP
720  REM
730  REM COMPUTE THE # OF RAFTERS

740  REM THERE COST AND WASTE
750  REM
755  REM FIND THE LENGTH
760 RL =  SQR ((.5 * LS) ^ 2 + (.
     5 * LS * RI) ^ 2)
770 RL = RL +  SQR (OE ^ 2 + (RI *
     OE) ^ 2)
780 RL = RL + (WR * RI)
784  REM
785  REM FIND THE # OF FEET
786  REM
790 R1 =  INT (RL)
794  REM
795  REM FIND THE # OF INCHES
796  REM
800 R2 = RL -  INT (RL)
810 R2 = R2 * 12
820 R2 = R2 * 100
830 R2 =  INT (R2)
840 R2 = R2 / 100
844  REM
845  REM FIND THE NEXT LARGER
846  REM EVEN LENGTH.
847  REM
850 R3 = R1
860  IF R3 <  > RL THEN R3 = R3 +
     1
870  IF R3 / 2 <  >  INT (R3 / 2)
      THEN R3 = R3 + 1
```

```
874  REM
875  REM FIND THE # NEEDED
876  REM
880 NR = (LP / SR + 1) * 2
884  REM
885  REM FIND THE COST
886  REM
890 CR = NR * R3 * C
892 CR =  INT ((CR * 100) + .5) /
     100
894  REM
895  REM FIND THE WASTE
896  REM
900 WR = NR * (R3 - RL)
901 WR =  INT ((WR / (R3 * NR)) *
     10000 + .5) / 100
910  REM
920  REM COMPUTE THE # OF JOIST
930  REM THEIR COST AND WASTE
940  REM
950  REM FIND THE # OF FEET
951  REM
960 J1 =  INT (LS)
964  REM
965  REM FIND THE # OF INCHES
966  REM
970 J2 = LS -  INT (LS)
980 J2 =  INT (J2 * 1200) / 100
984  REM
985  REM FIND THE NEXT LARGER
986  REM EVEN LENGTH.
987  REM
990 J3 = J1
1000  IF J3 <  > LS THEN J3 = J3 +
     1
1010  IF J3 / 2 <  >  INT (J3 / 2
     ) THEN J3 = J3 + 1
1014  REM
1015  REM FIND THE # NEEDED
1016  REM
1020 NJ = LP / SR + 1
1024  REM
1025  REM FIND THE COST
1026  REM
1030 CJ = NJ * J3 * C
1032 CJ =  INT ((CJ * 100) + .5) /
     100
1034  REM
1035  REM FIND THE WASTE
1036  REM
1040 WJ = NJ * (J3 - LS)
1041 WJ = (WJ / (J3 * NJ)) * 1000
     0
1042 WJ =  INT (WJ + .5) / 100
1050  REM
1060  REM COMPUTE THE LENGTH OF
1070  REM THE RIDGE BOARD AND
1080  REM THE FASCIAL BOARDS.
```

```
1081  REM
1082 LB = LP + (2 * OV)
1083  REM
1084  REM FIND THE # OF FEET
1085 B1 =  INT (LB)
1086  REM
1087  REM FIND THE # OF INCHES
1088 B2 = LB -  INT (LB)
1089 B2 =  INT ((B2 * 1200) + .5)
      / 100
1090  REM
1091  REM FIND THE NEXT LARGER
1092  REM EVEN LENGTH
1093  REM
1094 B3 = B1
1095  IF B3 <  > LB THEN B3 = B3 +
     1
1096  IF B3 / 2 <  >  INT (B3 / 2
     ) THEN B3 = B3 + 1
1097  REM
1098  REM COMPUTE THE COST
1099  REM
1100 CB = B3 * 3 * C
1101 CB =  INT (CB * 100 + .5) /
     100
1104  REM
1105  REM  COMPUTE THE WASTE
1106  REM
1107 WB = 3 * (B3 - LB)
1108 WB =  INT ((WB / (B3 * 3)) *
     1000 + .5) / 100
1109  REM
1110  REM COMPUTE THE NUMBER
1111  REM OF SQUARES.
1112  REM
1120 SQ = 2 * LB * (RL + (.5 * RT
     )) / 100
1125 SQ =  INT (SQ * 100 + .5) /
     100
1130  REM
1140  REM COMPUTE THE # OF
1150  REM PLYWOOD SHEETS NEEDED
1160  REM TO DECK THE ROOF.
1170  REM THEIR WASTE AND COST
1180  REM
1190  REM COMPUTE THE NEXT
1200  REM LARGER SIZE OF PLYWOOD
1210  REM FROM THE LENGTH OF THE
1220  REM RIDGEBOARD.
1230  REM
1240 P1 =  INT (LB / 4)
1250  IF P1 <  > LB / 4 THEN P1 =
     P1 + 1
1270  REM
1280  REM FIND VERTICAL SIZE
1290  REM
1300 P2 =  INT ((RL + (.5 * RT)) /
     2)
```

The final program in this group, and in this entire collection, is "CONCRETE". This program will estimate the cost and material needed to pour a concrete slab. For instance, suppose you had a slab 10' 0" by 15' 0", and 4" thick. Say this slab had #3 reinforcement bars(re-bars) that had a spacing of 16 inches. Also, let the slab have 4 concrete support beams. two that are 12" by 24" by 10' 0", with 4 #6 re-bars, and #3 strirrups 24" apart. The other two are 12" by 24" by 15" 0". They have 4 #6 re-bars and #3 strirrups that are 24" apart, and costing $0.43. The four beams are connected by four L-shaped conners. Further let's assume your slab has 4 peirs that have a 12" diameter and are 4' 6" long with bells. Also, the peirs have 2 #5 re-bars in them. Now let us consider the problem of estimating the cost if concrete cost $35.00 a yard, while #3 re-bars 20' long cost $8.25, #5's cost $9.75, and #6's cost $10.25. Given this information the program "CONCRETE" will give you an itemized list of materials needed and their cost, plus a total cost for all the material.

Now here is a sample run and listing of the program.

```
RUN CONCRETE


    THIS PROGRAM WILL HELP YOU FIGURE
THE COST, MATERIAL NEEDED, AND WASTE
OF A CONCRETE SLAB.


          DEMONSTRATION PROGRAM
         FOR EDUCATIONAL USE ONLY


    PRESS <RETURN> TO CONTINUE?



    TO RUN THIS PROGRAM YOU NEED TO
KNOW THE:
    DIMENSIONS OF THE SLAB.
    SIZE OF ALL REINFORCEMENT BARS.
    SPACING OF THE BARS WITHIN THE SLAB.
    DIMENSIONS OF ALL THE BEAMS.
    # OF RE-BARS TO GO IN EACH BEAM.
    SPACING & RE-BAR SIZE OF EACH
    STIRRUP.
    COST OF EACH STIRRUP.
    # OF L-SHAPED AND T-SHAPED CORNERS.
    DIMENSIONS OF ALL THE PEIRS.
    IF A GIVEN PEIR HAS A BELL.
    PRICE OF CONCRETE PER-YARD.
    PRICE OF 20FT OF RE-BAR FOR A
    A GIVEN SIZE, OR THE PRICE OF
    STEEL PER-POUND.


    DO YOU HAVE THIS INFORMATION (Y/N)?



    DIVIDE THE SLAB INTO RECTANGLES. HOW MANY RECTANGLE ARE THERE?1



    HOW LONG IS RECTANGLE 1 IN
FEET AND INCHES:
                    FEET?15
                    INCHES?0



    HOW WIDE IS RECTANGLE 1 IN
FEET AND INCHES:
```

```
                    FEET?10
                    INCHES?0


ENTER THE SLAB THICKNESS IN INCHES?4



   WHAT SIZE REINFORCEMENT BARS:

                 3 = SIZE #3
                 4 = SIZE #4
                 5 = SIZE #5
                 6 = SIZE #6
                 7 = SIZE #7
                 8 = SIZE #8


   WHAT IS THE SPACING BETWEEN THE BARS IN INCHES?16
   ENTER THE DIMENSIONS OF BEAM 1.

          THICKNESS IN INCHES?12
          DEPTH IN INCHES     ?24
          LENGTH IN FT & IN
                      FEET     ?10
                      INCHES   ?0


   ENTER THE QUANTITY & SIZE OF THE
REINFORCEMENT BARS TO GO IN BEAM 1.

   QUANTITY?4


                    SIZE

                 3 = SIZE #3
                 4 = SIZE #4
                 5 = SIZE #5
                 6 = SIZE #6
                 7 = SIZE #7
                 8 = SIZE #8


   ENTER THE SPACING & REINFORCEMENT
BAR SIZE OF THE STIRRUPS FOR BEAM 1.

   SPACING IN INCHES?24

                    SIZE
                 3 = SIZE #3
                 4 = SIZE #4
                 5 = SIZE #5
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```
                  6 = SIZE #6
                  7 = SIZE #7
                  8 = SIZE #8


     IS THERE ANOTHER BEAM WITH THE
SAME SPECIFICATIONS (Y/N)?
     HOW MANY?1



     IS THERE ANOTHER BEAM (Y/N)?     ENTER THE DIMENSIONS OF BEAM 2.

          THICKNESS IN INCHES?12
          DEPTH IN INCHES     ?24
          LENGTH IN FT & IN
                    FEET      ?15
                    INCHES    ?0


     ENTER THE QUANTITY & SIZE OF THE
REINFORCEMENT BARS TO GO IN BEAM 2.

     QUANTITY?4


                    SIZE

                  3 = SIZE #3
                  4 = SIZE #4
                  5 = SIZE #5
                  6 = SIZE #6
                  7 = SIZE #7
                  8 = SIZE #8


     ENTER THE SPACING & REINFORCEMENT
BAR SIZE OF THE STIRRUPS FOR BEAM 2.

     SPACING IN INCHES?24

                    SIZE
                  3 = SIZE #3
                  4 = SIZE #4
                  5 = SIZE #5
                  6 = SIZE #6
                  7 = SIZE #7
                  8 = SIZE #8


     IS THERE ANOTHER BEAM WITH THE
SAME SPECIFICATIONS (Y/N)?
     HOW MANY?1
     IS THERE ANOTHER BEAM (Y/N)?

WHAT IS THE COST OF A STIRRUP 9 BY 21
INCHES MADE OF              #3 RE-BAR?0.43


     ENTER THE NUMBER OF L-SHAPED
CONERS?4

     ENTER THE NUMBER OF T-SHAPED
CONERS?0




     DO YOU HAVE ANY PEIRS Y = YES?


     ENTER THE DIMENSIONS OF PEIR 1.
               DIAMETER IN INCHES?12
               LENGTH IN FT & IN
                              FEET  ?4
                              INCHES?6


     DOES PEIR 1 HAVE A BELL (Y/N)?


ENTER THE QUANTITY AND SIZE OF THE
REINFORCEMENT BARS TO GO INTO THE PEIR
          QUANTITY: ?2
          SIZE #3-#8 ?

     ARE THERE OTHER PEIRS WITH THE SAME SPECIFICATIONS (Y/N)?
     HOW MANY?3


     IS THERE ANOTHER PEIR (Y/N)?

     WASTE IS USAULLY FIGURED BETWEEN
5 AND 10 %. WHAT PERCENT OF WASTE
DO YOU WANT TO FIGURE IN?6


     WHAT IS THE PRICE OF CONCRETE
PER-YARD.?3500
```

```
     DO YOU WANT TO ENTER THE PRICE OF
STEAL IN POUNDS OR IN BARS (P/B)?B
WHAT IS THE COST OF A 20 FT #3 RE-BAR?8.25
WHAT IS THE COST OF A 20 FT #5 RE-BAR?9.75
WHAT IS THE COST OF A 20 FT #6 RE-BAR?10.25


     DO YOU WANT A HARDCOPY OF THE
OUTPUT (Y/N)?


     MAKE SURE THE PRINTER IS ON
AND SET THE PRINTER TO THE TOP OF THE
PAGE. THEN PRESS <RETURN>?


                 CONCRETE

AMOUNT: 6.7 YARDS          COST: $23201.19

          REINFORCEMENT BARS

SIZE      QUANTITY            COST
 #3       9 BARS              $74.25
 #5       2 BARS              $19.5
 #6       11 BARS             $112.75

                 STIRRUPS

RE-BAR SIZE           #       COST
 #3       9 X 21 IN   26      $11.18

                  CORNERS
QUANTITY: 16                  COST: $44

     TOTAL COST OF MATERIAL: $23462.88
```

```
]LIST

10  REM THIS IS A PROGRAM
20  REM TO ESTIMATE THE COST
30  REM OF A CONCRETE SLAB.
40  REM
50  REM ENTER NEEDED DATA
60  REM
70  HOME : PRINT : PRINT : PRINT

75  DIM W(10),L(10),BC(6)
76  DIM RS(6),RC(6),RW(6)
77  DIM S(10),SS(10,3)
80  PRINT  TAB( 5)"THIS PROGRAM W
     ILL HELP YOU FIGURE"
90  PRINT "THE COST, MATERIAL NEE
     DED, AND WASTE"
100  PRINT "OF A CONCRETE SLAB."
101  PRINT : PRINT : PRINT
102  INVERSE
103  HTAB 10: PRINT "DEMONSTRATIO
     N PROGRAM"
104  HTAB 9: PRINT "FOR EDUCATION
     AL USE ONLY"
105  NORMAL
106  PRINT : PRINT : PRINT
107  PRINT  TAB( 5)"PRESS <RETURN
     > TO CONTINUE";: INPUT X$
108  HOME : PRINT : PRINT : PRINT

110  PRINT
120  PRINT  TAB( 5)"TO RUN THIS P
     ROGRAM YOU NEED TO"
130  PRINT "KNOW THE:"
131  PRINT  TAB( 5)"DIMENSIONS OF
      THE SLAB."
132  PRINT  TAB( 5)"SIZE OF ALL R
     EINFORCEMENT BARS."
133  PRINT  TAB( 5)"SPACING OF TH
     E BARS WITHIN THE SLAB."
134  PRINT  TAB( 5)"DIMENSIONS OF
      ALL THE BEAMS."
135  PRINT  TAB( 5)"# OF RE-BARS
     TO GO IN EACH BEAM."
136  PRINT  TAB( 5)"SPACING & RE-
     BAR SIZE OF EACH": PRINT  TAB(
     5)"STIRRUP."
137  PRINT  TAB( 5)"COST OF EACH
     STIRRUP."
138  PRINT  TAB( 5)"# OF L-SHAPED
      AND T-SHAPED CORNERS."
139  PRINT  TAB( 5)"DIMENSIONS OF
      ALL THE PEIRS."
140  PRINT  TAB( 5)"IF A GIVEN PE
     IR HAS A BELL."
141  PRINT  TAB( 5)"PRICE OF CONC
```

```
      RETE PER-YARD."
142   PRINT  TAB( 5)"PRICE OF 20FT
       OF RE-BAR FOR A"
143   PRINT  TAB( 5)"A GIVEN SIZE,
       OR THE PRICE OF"
144   PRINT  TAB( 5)"STEEL PER-POU
      ND."
160   PRINT : PRINT : PRINT
170   PRINT  TAB( 5)"DO YOU HAVE T
      HIS INFORMATION (Y/N)?";: GET
      X$
180   IF X$ = "N" THEN  END
190   IF X$ <  > "Y" THEN  PRINT :
       PRINT : PRINT : GOTO 170
200   HOME : PRINT : PRINT : PRINT
      : PRINT : PRINT
205   REM ENTER # OF SLABS
210   PRINT  TAB( 5)"DIVIDE THE SL
      AB INTO RECTANGLES. HOW MANY
       RECTANGLE ARE THERE";: INPUT
      NR
215   REM ENTER SLAB DIMENSIONS
220   FOR I = 1 TO NR
230   PRINT : PRINT : PRINT
240   PRINT  TAB( 5)"HOW LONG IS R
      ECTANGLE ";I;" IN"
250   PRINT "FEET AND INCHES:"
260   PRINT  TAB( 20)"FEET";: INPUT
      F
270   PRINT  TAB( 20)"INCHES";: INPUT
       IN
280  IN = IN / 12
290  L(I) = F + IN
300   PRINT : PRINT : PRINT
310   PRINT  TAB( 5)"HOW WIDE IS R
      ECTANGLE ";I;" IN"
320   PRINT "FEET AND INCHES:"
330   PRINT  TAB( 20)"FEET";: INPUT
      F
340   PRINT  TAB( 20)"INCHES";: INPUT
       IN
350  IN = IN / 12
355  W(I) = F + IN
360   HOME
370   NEXT I
380   PRINT : PRINT : PRINT
390   PRINT  TAB( 3)"ENTER THE SLA
      B THICKNESS IN INCHES";: INPUT
       IN
392  IN = IN / 12
395  TS = IN
400   HOME : PRINT : PRINT : PRINT
       : PRINT
402   REM ENTER SIZE AND
403   REM SPACING OF REINFOCEMENT
404   REM BARS TO GO IN SLABS.
410   PRINT  TAB( 5)"WHAT SIZE REI
      NFORCEMENT BARS:"
```

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```
420  PRINT
430  PRINT  TAB( 15)"3 = SIZE #3"

440  PRINT  TAB( 15)"4 = SIZE #4"

450  PRINT  TAB( 15)"5 = SIZE #5"

460  PRINT  TAB( 15)"6 = SIZE #6"

470  PRINT  TAB( 15)"7 = SIZE #7"

480  PRINT  TAB( 15)"8 = SIZE #8"

490  GET X
495  IF X < 3 OR X > 8 THEN 410
496 X = X - 2
560  PRINT : PRINT : PRINT : PRINT
      TAB( 5)"WHAT IS THE SPACING
      BETWEEN THE BARS IN INCHES"
     ;: INPUT SB
565 SB = SB / 12
566  REM
567  REM LOOP TO FIGURE
568  REM FEET OF BARS.
569  REM
570 NB = 0
580  FOR I = 1 TO NR
590 NB = NB + (((W(I) / SB) * (L(
     I) / SB)) * 2)
595 AC = AC + W(I) * L(I) * TS
600  NEXT I
610 RS(X) = NB
620 N = 1
630  HOME
635  REM ENTER BEAM DIMENSIONS
640  PRINT  TAB( 5)"ENTER THE DIM
     ENSIONS OF BEAM ";N;"."
650  PRINT
660  PRINT  TAB( 10)"THICKNESS IN
      INCHES";: INPUT TH
665 TH = TH / 12
670  PRINT  TAB( 10)"DEPTH IN INC
     HES     ";: INPUT D
675 D = D / 12
680  PRINT  TAB( 10)"LENGTH IN FT
      & IN  "
690  PRINT  TAB( 20)"FEET      ";:
      INPUT F
700  PRINT  TAB( 20)"INCHES    ";:
      INPUT IN
710 IN = IN / 12
720 F = F + IN
725 AC = AC + TH * D * F
790  HOME
795  PRINT : PRINT : PRINT
800  PRINT  TAB( 5)"ENTER THE QUA
     NTITY & SIZE OF THE"
810  PRINT "REINFORCEMENT BARS TO
```

```
     GO IN BEAM ";N;"."
820  PRINT
830  PRINT  TAB( 5)"QUANTITY";: INPUT
     Q
840  PRINT : PRINT
850  PRINT  TAB( 18)"SIZE"
860  PRINT
870  PRINT  TAB( 15)"3 = SIZE #3"

880  PRINT  TAB( 15)"4 = SIZE #4"

890  PRINT  TAB( 15)"5 = SIZE #5"

900  PRINT  TAB( 15)"6 = SIZE #6"

910  PRINT  TAB( 15)"7 = SIZE #7"

920  PRINT  TAB( 15)"8 = SIZE #8"

930  GET X
935  IF X < 3 OR X > 8 THEN 850
936 X = X - 2
940 RS(X) = RS(X) + Q * F
950  HOME : PRINT : PRINT : PRINT

960  PRINT  TAB( 5)"ENTER THE SPA
     CING & REINFORCEMENT"
970  PRINT "BAR SIZE OF THE STIRR
     UPS FOR BEAM ";N;"."
980  PRINT
990  PRINT  TAB( 5)"SPACING IN IN
     CHES";: INPUT IN
1000 IN = IN / 12
1010  PRINT
1020  PRINT  TAB( 18)"SIZE"
1030  PRINT  TAB( 15)"3 = SIZE #3
     "
1040  PRINT  TAB( 15)"4 = SIZE #4
     "
1050  PRINT  TAB( 15)"5 = SIZE #5
     "
1060  PRINT  TAB( 15)"6 = SIZE #6
     "
1070  PRINT  TAB( 15)"7 = SIZE #7
     "
1080  PRINT  TAB( 15)"8 = SIZE #8
     "
1090  GET Y
1095  IF Y < 3 OR Y > 8 GOTO 1010

1096 Y = Y - 2
1097 J = 1
1098  IF SS(J,1) = (TH * 12) - 3 AND
     SS(J,2) = (D * 12) - 3 AND S
     S(J,3) = Y THEN S(J) = S(J) +
      INT (F / IN + .5): GOTO 110
     0
1099  IF J < > N THEN J = J + 1:
```

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```
      GOTO 1098
1100  IF J = N THEN S(J) =  INT (
     F / IN + .5):SS(J,1) = (TH *
     12) - 3:SS(J,2) = (D * 12) -
     3:SS(J,3) = Y
1101  PRINT : PRINT
1102  PRINT  TAB( 5)"IS THERE ANO
     THER BEAM WITH THE"
1103  PRINT "SAME SPECIFICATIONS
     (Y/N)?": GET A$
1104  IF A$ = "N" GOTO 1110
1105  PRINT  TAB( 5)"HOW MANY";: INPUT
     K
1106  FOR I = 1 TO K:AC = AC + TH
      * D * F:RS(X) = RS(X) + Q *
     F:S(J) = S(J) +  INT (F / IN
      + .5): NEXT I
1110  PRINT : PRINT : PRINT : PRINT

1120  PRINT  TAB( 5)"IS THERE ANO
     THER BEAM (Y/N)?";: GET X$
1130  HOME
1140  IF X$ = "Y" THEN N = N + 1:
      GOTO 640
1149  PRINT : PRINT : PRINT
1150  FOR I = 1 TO 10
1151  IF S(I) = 0 GOTO 1159
1152  PRINT "WHAT IS THE COST OF
     A STIRRUP ";SS(I,1);" BY ";S
     S(I,2): PRINT "INCHES MADE O
     F                #";SS(I,3) + 2
     ;" RE-BAR";: INPUT K
1153 SC(I) =  INT (K * S(I) * 100
      + .5) / 100
1159  NEXT I
1160  HOME : PRINT : PRINT : PRINT

1161  REM
1162  REM ***CORNERS***
1163  REM
1165. PRINT  TAB( 5)"ENTER THE NU
     MBER OF L-SHAPED"
1170  PRINT "CONERS";: INPUT C
1180  PRINT : PRINT  TAB( 5)"ENTE
     R THE NUMBER OF T-SHAPED"
1190  PRINT "CONERS";: INPUT TC
1200 C = C + TC
1210 C = C * 4
1220  HOME : PRINT : PRINT : PRINT

1222  REM
1223  REM ***PEIRS***
1224  REM
1225 N = 1
1226  PRINT : PRINT : PRINT
1227  PRINT  TAB( 5)"DO YOU HAVE
     ANY PEIRS Y = YES?": GET X$
1228  PRINT : PRINT : PRINT
```

```
1229  IF X$ <  > "Y" GOTO 1330
1230  PRINT  TAB( 5)"ENTER THE DI
     MENSIONS OF PEIR ";N;"."
1240  PRINT  TAB( 15)"DIAMETER IN
      INCHES";: INPUT DI
1241 DI = DI / 12
1250  PRINT  TAB( 15)"LENGTH IN F
     T & IN"
1251  PRINT  TAB( 27)"FEET  ";: INPUT
     F
1252  PRINT  TAB( 27)"INCHES";: INPUT
     IN
1253 F = F + (IN / 12)
1254 P = P + (((DI / 2) ^ 2) * 3.
     1416 * F)
1260  PRINT : PRINT : PRINT
1270  PRINT  TAB( 5)"DOES PEIR ";
     N;" HAVE A BELL (Y/N)?";: GET
     X$
1275 LP = 1.5 * DI
1280  IF X$ = "Y" THEN BE = BE +
     (((DI / 2) ^ 2) * 3.1416 * L
     P)
1290  PRINT : PRINT : PRINT
1291  PRINT "ENTER THE QUANTITY A
     ND SIZE OF THE": PRINT "REIN
     FORCEMENT BARS TO GO INTO TH
     E PEIR"
1292  PRINT  TAB( 10)"QUANTITY: "
     ;: INPUT Q
1293  PRINT  TAB( 10)"SIZE #3-#8
     ?";: GET X
1294 X = X - 2
1295 RS(X) = RS(X) + Q * F
1296  PRINT : PRINT : PRINT  TAB(
     5)"ARE THERE OTHER PEIRS WIT
     H THE SAME SPECIFICATIONS (Y
     /N)?": GET A$
1297  IF A$ = "N" GOTO 1300
1298  PRINT  TAB( 5)"HOW MANY";: INPUT
     Y: FOR I = 1 TO Y:P = P + ((
     (DI / 2) ^ 2) * 3.1416 * F):
      IF X$ = "Y" THEN BE = BE +
     (((DI / 2) ^ 2) * 3.1416 * L
     P):RS(X) = RS(X) + Q * F
1299  NEXT I
1300  PRINT : PRINT : PRINT
1305  PRINT  TAB( 5)"IS THERE ANO
     THER PEIR (Y/N)?";: GET X$
1310  HOME : PRINT : PRINT : PRINT

1320  IF X$ = "Y" THEN N = N + 1:
      GOTO 1230
1321 P = P + BE
1330  PRINT  TAB( 5)"WASTE IS USA
     ULLY FIGURED BETWEEN"
1340  PRINT "5 AND 10 %. WHAT PER
     CENT OF WASTE"
```

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```
1350  PRINT "DO YOU WANT TO FIGUR
     E IN";: INPUT WA
1351 WA = WA / 100
1360  HOME : PRINT : PRINT : PRINT

1370  PRINT  TAB( 5)"WHAT IS THE
     PRICE OF CONCRETE"
1380  PRINT "PER-YARD.";: INPUT C
     P
1381  HOME : PRINT : PRINT : PRINT

1382  PRINT  TAB( 5)"DO YOU WANT
     TO ENTER THE PRICE OF"
1383  PRINT "STEAL IN POUNDS OR I
     N BARS (P/B)";: INPUT J$
1384  IF J$ = "P" GOTO 1399
1385  IF J$ <  > "B" GOTO 1381
1386  FOR I = 1 TO 6
1387  IF RS(I) <  > 0 THEN  PRINT
     "WHAT IS THE COST OF A 20 FT
      #";I + 2;" RE-BAR";: INPUT
     BC(I)
1388  NEXT I
1389  GOTO 1420
1399  PRINT : PRINT : PRINT
1400  PRINT  TAB( 5)"WHAT IS THE
     PRICE OF STEEL "
1410  PRINT "PER-POUND";: INPUT C
     S
1420  HOME : PRINT : PRINT : PRINT

1430  REM
1440  REM COMPUTE MATERIAL
1450  REM AND COST
1460  REM
1470  REM COMPUTE CONCRETE
1520 AC = AC + P
1530 AC = AC / 27
1531 CW = AC * WA
1532 AC = AC + CW
1540 CT = AC * CP
1545 AC =  INT (AC * 10 + 1) / 10

1546 CT =  INT (CT * 100 + .5) /
     100
1550  REM
1560  REM COMPUTE RE-BARS
1570  REM
1571  REM SET RE-BAR WEIGHT
1572 RP(1) = .376
1573 RP(2) = .668
1574 RP(3) = 1.043
1575 RP(4) = 1.502
1576 RP(5) = 2.044
1577 RP(6) = 2.67
1580  FOR X = 1 TO 6
1582 RW(X) = RS(X) * WA
1584 RS(X) = RS(X) + RW(X)
```

```
1585  IF RS(X) / 20 =  INT (RS(X)
     / 20) THEN K =  INT (RS(X) /
     20)
1586  IF RS(X) / 20 <  >  INT (RS
     (X) / 20) THEN K =  INT (RS(
     X) / 20) + 1
1587 RS(X) = K
1590  IF J$ = "P" THEN RC(X) = RS
     (X) * RP(X) * CS * 20
1595  IF J$ = "B" THEN RC(X) = RS
     (X) * BC(X)
1600  NEXT X
1800  REM
1801  PRINT  TAB( 5)"DO YOU WANT
     A HARDCOPY OF THE"
1802  PRINT "OUTPUT (Y/N)?": GET
     X$
1803  IF X$ <  > "Y" GOTO 1809
1804  PRINT : PRINT : PRINT  TAB(
     5)"MAKE SURE THE PRINTER IS
     ON"
1805  PRINT "AND SET THE PRINTER
     TO THE TOP OF THE"
1806  PRINT "PAGE. THEN PRESS <RE
     TURN>";: INPUT A$
1808  PRINT  CHR$ (4);"PR#1"
1809  HOME : PRINT : PRINT : PRINT

1810  REM OUTPUT CHART
1820  REM
1830  PRINT  TAB( 16)"CONCRETE"
1840  PRINT
1850  PRINT "AMOUNT: ";AC;" YARDS
     ";: HTAB 25: PRINT "COST: $"
     ;CT
1860  PRINT
1870  PRINT  TAB( 8)"REINFORCEMEN
     T BARS"
1872  PRINT
1873  PRINT "SIZE";: HTAB 8: PRINT
     "QUANTITY";: HTAB 25: PRINT
     "COST"
1880  FOR X = 1 TO 6
1885  IF RS(X) <  > 0 THEN  PRINT
     " #";X + 2;: HTAB 8: PRINT R
     S(X);" BARS";: HTAB 25: PRINT
     "$"; INT (RC(X) * 100 + .5) /
     100
1890  NEXT X
1895  PRINT
1900  PRINT  TAB( 16)"STIRRUPS"
1910  PRINT
1920  PRINT "RE-BAR";: HTAB 8: PRINT
     "SIZE";: HTAB 20: PRINT "#";
     : HTAB 25: PRINT "COST"
1940  FOR I = 1 TO 10
1950  IF S(I) = 0 GOTO 1970
1960  PRINT " #";SS(I,3) + 2;: HTAB
```

```
     8: PRINT SS(I,1);" X ";SS(I,
     2);" IN";: HTAB 20: PRINT S(
     I);: HTAB 25: PRINT "$"SC(I)

1970  NEXT I
1980  PRINT
1990  PRINT  TAB( 17)"CORNERS"
2000  PRINT "QUANTITY: ";C;: HTAB
     25: PRINT "COST: $"; INT (C *
     100 * 2.75 + .5) / 100
2020 T = CT
2030  FOR I = 1 TO 6
2040 T = T + RC(I)
2050  NEXT I
2060  FOR I = 1 TO 10
2070 T = T + SC(I)
2080  NEXT I
2090 T = T + C * 2.75
2100 T =  INT (T * 100 + 1) / 100

2110  PRINT : PRINT  TAB( 5)"TOTA
     L COST OF MATERIAL: $";T
2120  IF X$ = "Y" THEN  PRINT  CHR$
     (12): PRINT  CHR$ (4);"PR#0"

2130  END

]
```

MANAGEMENT

This group of programs deals with Management and finances.

The first program is a program to figure the current value of a Treasury Bill. Treasury Bill's are bought and sold at a discount from their face value, prior to reaching maturity, and dicounts are figured as if a year were 360 days.

This program will read the face value of the bill, the date it was issued, when it matures, todays date, and the price bid for today. Then it will ouput the current value of the bill.

While running this program you must enter dates as month followed by a comma, day followed by a comma, and year followed by a comma.

An example of a run of this program would be if you had a bill with a face value of $15,000, that was issued on 3,5,83; and it maturies on 1,1,84. Say todays date is 11,5,83; and the price bid is 14%. If you enter these values at the proper time while running the program it would output the current value of the bill.

Here is a sample run and listing of the program.

```
]RUN TREASURY BILL


    THIS IS A PROGRAM TO FIND THE
CURRENT VALUE OF A TRESURY BILL.
         DEMONSTRATION PROGRAM
        FOR EDUCATIONAL USE ONLY



    PRESS <RETURN> TO CONTINUE?



    ENTER THE FACE VALUE (IN DALLORS)?15000

WHEN WAS IT ISSEUED:
    EX. 10,28,82
         MONTH ?3
         DAY   ?5
         YEAR  ?83

WHEN WILL IT MATURE:
         MONTH ?1
         DAY   ?1
         YEAR  ?84

WHAT IS TODAY'S DATE:
         MONTH ?11
         DAY   ?5
         YEAR  ?83

WHAT IS THE CURRENT PRICE BID (IN       PERCENT)?14


    THE BILL'S CURRENT VALUE IS $14667.5

    DO YOU WANT TO DO ANOTHER (Y/N)?
]LIST

9  HOME : PRINT : PRINT : PRINT
10  PRINT  TAB( 5)"THIS IS A PROG
     RAM TO FIND THE "
20  PRINT "CURRENT VALUE OF A TRE
     SURY BILL."
22  VTAB 10
23  INVERSE
24  HTAB 10: PRINT "DEMONSTRATION
      PROGRAM"
25  HTAB 9: PRINT "FOR EDUCATIONA
     L USE ONLY"
26  NORMAL
27  PRINT : PRINT : PRINT
28  PRINT  TAB( 5)"PRESS <RETURN>
      TO CONTINUE";: INPUT A$
```

```
30  HOME : PRINT : PRINT : PRINT

40  DEF  FN R(X) =  INT (X * 100 +
     .5) / 100
50  PRINT
60  PRINT  TAB( 5)"ENTER THE FACE
      VALUE (IN DALLORS)";
70  INPUT P
80  PRINT
90  PRINT "WHEN WAS IT ISSEUED:"
95  PRINT  TAB( 5)"EX. 10,28,82"
100  PRINT  TAB( 10)"MONTH ";: INPUT
     M
105  IF M < 0 OR M > 12 THEN  PRINT
     "REENTER": GOTO 100
110  PRINT  TAB( 10)"DAY   ";: INPUT
     D
115  IF D < 0 OR D > 31 THEN  PRINT
     "REENTER": GOTO 110
120  PRINT  TAB( 10)"YEAR  ";: INPUT
     Y
125  IF Y < 0 OR Y > 99 THEN  PRINT
     "REENTER": GOTO 120
130  PRINT
140  GOSUB 550
150  REM X3 IS THE ABSOLUTE # OF

160  REM DAYS FROM THE IMAGINARY

170  REM DATE 0-0-0 TO THE
180  REM ISSUE DATE.
190 X3 = A4
200  PRINT "WHEN WILL IT MATURE:"

210  PRINT  TAB( 10)"MONTH ";: INPUT
     M
215  IF M < 0 OR M > 12 THEN  PRINT
     "REENTER": GOTO 210
220  PRINT  TAB( 10)"DAY   ";: INPUT
     D
225  IF D < 0 OR D > 31 THEN  PRINT
     "REENTER": GOTO 220
230  PRINT  TAB( 10)"YEAR  ";: INPUT
     Y
235  IF Y < 0 OR Y > 99 THEN  PRINT
     "REENTER": GOTO 230
240  PRINT
250  GOSUB 550
260  REM X3 IS THE TOTAL # OF
270  REM DAYS IN THE PERIOD
280 X4 =  ABS (X3 - A4)
290  PRINT "WHAT IS TODAY'S DATE:
     "
300  PRINT  TAB( 10)"MONTH ";: INPUT
     M
305  IF M < 0 OR M > 12 THEN  PRINT
     "REENTER": GOTO 300
310  PRINT  TAB( 10)"DAY   ";: INPUT
     D
```

```
315  IF D < 0 OR D > 31 THEN  PRINT
     "REENTER": GOTO 310
320  PRINT  TAB( 10)"YEAR  ";: INPUT
     Y
325  IF Y < 0 OR Y > 99 THEN  PRINT
     "REENTER": GOTO 320
330  PRINT
340  GOSUB 550
350  REM X3 IS THE # OF DAYS FROM

360  REM ISSUE TO TODAY
370 X3 =  ABS (X3 - A4)
380  PRINT "WHAT IS THE CURRENT P
     RICE BID (IN        PERCENT)"
     ;
390  INPUT B
400  REM X4 IS THE # OF DAYS LEFT

410  REM LEFT UNTIL MATURITY
420 X4 = X4 - X3
430  PRINT : PRINT : PRINT
440  REM CV IS THE CURRENT
450  REM VALUE OF THE BILL
460 CV =  FN R(P - ((P / 1E4) * (
     B * (X4 / 360) * 100)))
470  PRINT  TAB( 5)"THE BILL'S CU
     RRENT VALUE IS $";CV
480  PRINT
490  PRINT  TAB( 5)"DO YOU WANT T
     O DO ANOTHER (Y/N)?";
500  GET A$
510  IF A$ = "Y" THEN  HOME : PRINT
     : PRINT : PRINT : GOTO 50
520  IF A$ = "N" GOTO 680
530  PRINT : PRINT : PRINT "ILLEG
                AL ENTRY, TRY AG
     AIN.": PRINT : PRINT : PRINT

540  GOTO 480
550  REM SUBROUTINE TO DETERMINE
560  REM THE # OF DAYS BETWEEN
570  REM DATE 0-0-0 AND M-D-Y
580  REM USING 365/366 DAY YEAR.
590  REM
600  RESTORE
610  DATA   0,3,3,6,8,11,13,16,19
     ,              21,24,26
620  FOR I1 = 1 TO M
630  READ A4
640  NEXT I1
650 A4 = A4 + Y * 365 +  INT (Y /
     4) + 1 + (M - 1) * 28 + D
660  IF  INT (Y / 4) = Y / 4 AND
     M < 3 THEN A4 = A4 - 1
670  RETURN
680  END

]
```

The second program is "INTEREST ON BONDS". This program will calculates accrued interest to date on bonds. It will allow you to use either a 360 or a 365/366 day year. sometimes a bond is issued after the first period has begun a this results in a first coupon payment of less than the normal amount. Some isseues skip that payment and include it with the second. if this is the case press Y when the program ask coupon involves a long first period, and enter the additional dates.

dates should be entered as month comma, followed by day comma, followed by year <RETURN>.

An example problem to solve with this program would be; what is the accrued interest on 11,17,82 of a 12.09% bond due on 12,10,84 and isseued 11,05,80, with a long first period, and 2 coupons per year. The coupon dates are 6,10 and 12,10. The first period began on 12,10,80.

Here is a sample run of the program to solve this problem, followed by a listing of the program.

```
RUN INTEREST ON BONDS


    THIS IS A PROGRAM TO FIGURE THE
ACCURED INTEREST ON A BOND.
         DEMONSTRATION PROGRAM
        FOR EDUCATIONAL USE ONLY


    PRESS <RETURN> TO CONTINUE?


    DO YOU WANT TO USE:
              1 = 360 DAY YEAR
              2 = 365/266 DAY YEAR


WHAT IS THE COUPON RATE, IN PERCENT?12.06


    HOW MANY COUPONS ARE THERE,
EACH YEAR?2


    DOES THIS COUPON INCLUDE A LONG
FIRST PERIOD (Y/N)?


    WHEN IS THE BEGINNING OF THE FIRST
PERIOD. GIVE THE MONTH, DAY, AND YEAR.
    EX.  9,27,80
         MONTH   ?12
         DAY     ?10
         YEAR    ?80


    WHEN WAS THE BOND ISSUED
         MONTH   ?11
         DAY     ?5
         YEAR    ?80


    WHEN IS THE FIRST COUPON DATE
         MONTH   ?6
         DAY     ?10
         YEAR    ?81


    WHEN WILL THE CURRENT PERIOD END
```

```
            MONTH    ?12
            DAY      ?10
            YEAR     ?82


        WHEN IS THE SETTLEMENT DATE
            MONTH    ?12
            DAY      ?10
            YEAR     ?84




        THE ACCRUED INTEREST IS 12.5601071% OF PAR.



        DO YOU WANT TO RUN THIS PROGRAM
     AGAIN (Y/N)?

     ]LIST

     10  HOME : PRINT : PRINT : PRINT

     20  PRINT  TAB( 5)"THIS IS A PROG
          RAM TO FIGURE THE"
     30  PRINT "ACCURED INTEREST ON A
          BOND."
     40  VTAB 10
     50  INVERSE
     60  HTAB 10: PRINT "DEMONSTRATION
           PROGRAM"
     70  HTAB 9: PRINT "FOR EDUCATIONA
          L USE ONLY"
     80  NORMAL
     90  PRINT : PRINT : PRINT :
     100  PRINT  TAB( 5)"PRESS <RETURN
           > TO CONTINUE";: INPUT A$
     110  HOME : PRINT : PRINT : PRINT

     120  PRINT  TAB( 5)"DO YOU WANT T
           O USE:"
     130  PRINT  TAB( 15)"1 = 360 DAY
           YEAR"
     140  PRINT  TAB( 15)"2 = 365/266
           DAY YEAR"
     145  PRINT : PRINT : PRINT
     150  GET X
     160  IF X <  > 1 AND X <  > 2 THEN
            PRINT  TAB( 5)"ILLEGAL ENTR
           Y, TRY AGAIN.": PRINT : PRINT
           : PRINT : GOTO 120
     170  PRINT "WHAT IS THE COUPON RA
           TE, IN PERCENT";: INPUT R
     180  PRINT : PRINT : PRINT
     190  PRINT  TAB( 5)"HOW MANY COUP
     ONS ARE THERE,"
195  PRINT "EACH YEAR";: INPUT NC

200 I1 = 0
210  PRINT : PRINT : PRINT
220  PRINT  TAB( 5)"DOES THIS COU
     PON INCLUDE A LONG"
230  PRINT "FIRST PERIOD (Y/N)?";
     : GET A$: PRINT
240  PRINT : PRINT : PRINT
250  IF A$ = "N" GOTO 400
260  IF A$ <  > "Y" THEN  PRINT  TAB(
     5)"ILLEGAL ENTRY, TRY AGAIN.
     ": PRINT : PRINT : PRINT : GOTO
     220
270  REM LONG FIRST PERIOD
280  PRINT  TAB( 5)"WHEN IS THE B
     EGINNING OF THE FIRST"
290  PRINT "PERIOD. GIVE THE MONT
     H, DAY, AND YEAR."
292  PRINT  TAB( 5)"EX.  9,27,80"

294  GOSUB 1000
300 I2 = J
310  REM ENTER ISSUE DATE
320  PRINT  TAB( 5)"WHEN WAS THE
     BOND ISSUED"
330  GOSUB 1000
340 I1 =  ABS (I2 - J)
350  PRINT  TAB( 5)"WHEN IS THE F
     IRST COUPON DATE"
360  GOSUB 1000
365  REM I2-DAYS IN FIRST PERIOD
370 I2 =  ABS (I2 - J)
380 I1 = (I2 - I1) / I2
390  GOTO 420
400  PRINT  TAB( 5)"WHEN WAS THE
     BEGINNING OF THE CURRENT"
410  PRINT "PERIOD": GOSUB 1000
420 I3 = J
430  PRINT  TAB( 5)"WHEN WILL THE
      CURRENT PERIOD END"
440  GOSUB 1000
450  REM I4-DAYS IN CURRENT PER
460 I4 =  ABS (I3 - J)
470  PRINT  TAB( 5)"WHEN IS THE S
     ETTLEMENT DATE"
480  GOSUB 1000
490 I3 =  ABS (I3 - J)
500 I3 = (I3 / I4) + I1
505 I = (R / NC) * I3
510  HOME : PRINT : PRINT : PRINT

520  PRINT  TAB( 5)"THE ACCRUED I
     NTEREST IS ";I;"% OF PAR."
530  PRINT : PRINT : PRINT
540  PRINT  TAB( 5)"DO YOU WANT T
     O RUN THIS PROGRAM"
550  PRINT "AGAIN (Y/N)?";: GET A
```

```
    $: PRINT
560  IF A$ = "Y" GOTO 120
570  END
1000  PRINT  TAB( 10)"MONTH   ";:
      INPUT M
1010  PRINT  TAB( 10)"DAY     ";:
      INPUT D
1020  PRINT  TAB( 10)"YEAR    ";:
      INPUT Y
1025  PRINT : PRINT : PRINT
1030  IF X = 1 THEN 1150
1040  REM FIND THE # OF DAYS
1045  REM FROM 0,0,0 TO M,D,Y
1046  REM USING A 365/366 DAY
1047  REM YEAR.
1050  RESTORE
1060  DATA  0,3,3,6,8,11,13,16,19
     ,21,24,26
1070  FOR Z = 1 TO M
1080  READ J
1090  NEXT Z
1100 J = J + Y * 365 +  INT (Y /
     4) + 1 + (M - 1) * 28 + D
1110  IF  INT (Y / 4) <  > Y / 4 OR
     M > 2 THEN  RETURN
1120 J = J - 1
1130  RETURN
1140  REM USING A 360 DAY YEAR
1150 J = (Y * 360) + (M * 360) +
     D
1160  RETURN

]
```

The next program is "CONTINUOUS INTEREST COMPOUND". This program calculates the future value of an investment with interest compounded continuosly.

An example problem to solve with this program would be if you invested $2,000 at 7.75% interest what will you have earned in 2 years. Here is a sample run to solve this problem, and a listing of the program.

```
RUN CONTINUOUS INTEREST COMPOUND


    THIS IS A PROGRM TO FIGURE
CONTINUOUS INTEREST COMPOUNDING.
         DEMONSTRATION PROGRAM
        FOR EDUCATIONAL USE ONLY


    PRESS <RETUEN> TO CONTINUE?




    WHAT IS THE ANNUAL RATE OF INTEREST
TO BE PAID ON THE ACCOUNT?7.75


    HOW MANY YEARS WILL INTEREST
ACCRUE, (ENTER FRACTIONS OF YEARS IN
DECIMAL FORM  EXAMPLE 5.75)?2


    WHAT WAS YOUR INITIAL DEPOSIT?2000


    CONTINUOUSLY COMPOUNDING AT A RATE
OF 7.75%, OVER 2 YEARS, A DEPOSIT
OF $2000 WILL GROW TO $2335.32

]LIST

10  HOME : PRINT : PRINT : PRINT

80  PRINT  TAB( 5)"THIS IS A PROG
     RM TO FIGURE"
90  PRINT "CONTINUOUS INTEREST CO
     MPOUNDING."
92  VTAB 10
93  INVERSE
```

```
94  HTAB 10: PRINT "DEMONSTRATION
      PROGRAM"
95  HTAB (9): PRINT "FOR EDUCATIO
     NAL USE ONLY"
96  NORMAL : PRINT : PRINT : PRINT
     : PRINT  TAB( 5)"PRESS <RETU
     EN> TO CONTINUE";: INPUT A$
97  HOME : PRINT : PRINT : PRINT

100  HOME : PRINT : PRINT : PRINT

110  PRINT  TAB( 5)"WHAT IS THE A
     NNUAL RATE OF INTEREST"
120  PRINT "TO BE PAID ON THE ACC
     OUNT";
130  INPUT I
140  IF 1 <  = 0 THEN 110
150  PRINT : PRINT : PRINT
160  PRINT  TAB( 5)"HOW MANY YEAR
     S WILL INTEREST"
170  PRINT "ACCRUE, (ENTER FRACTI
     ONS OF YEARS IN"
180  PRINT "DECIMAL FORM  EXAMPLE
      5.75)";
190  INPUT N
200  IF N <  = 0 THEN 150
210  PRINT : PRINT : PRINT
220  PRINT  TAB( 5)"WHAT WAS YOUR
      INITIAL DEPOSIT";
230  INPUT D
240  IF D <  = 0 THEN 220
250  HOME : PRINT : PRINT : PRINT

260  PRINT  TAB( 5)"CONTINUOUSLY
     COMPOUNDING AT A RATE"
270  PRINT "OF ";I;"%, OVER ";N;"
      YEARS, A DEPOSIT"
280  PRINT "OF $";D;" WILL GROW T
     O $"; INT (100 * (D *  EXP (
     I / 100 * N)) + .5) / 100
290  END

]
```

The next program is "TAX DEDUCTION". This program computes the amount of savings you might realize by deducting interest payments.

An example problem for this program would be if there was a tax rate of 50%, and an interest rate of 14.05%, with projected interest payments of $4,000, $5,000, $6,000, and $4,500 over the next 4 years what would be the present value of the tax savings. Here is a sample run of the program to solve this problem, and a listing of the program.

```
RUN TAX DEDUCTION
    THIS IS A PROGRAM TO FIGURE THE
PRESENT VALUE OF AN INTEREST TAX
DEDUCATION.
         DEMONSTRATION PROGRAM
        FOR EDUCATIONAL USE ONLY



    PRESS <RETURN> TO CONTINUE?



    WHAT IS THE TAX RATE, IN PERCENT?50

    WHAT IS THE INTEREST RATE, IN       PERCENT?14.05

    HOW MANY PERIODS ARE THERE?4

    WHAT IS THE INTEREST AMOUNT FOR
 PERIOD 1 $?4000
          PERIOD 2 $?5000
          PERIOD 3 $?6000
          PERIOD 4 $?4500



THE PRESENT VALUE OF THE DEDUCTION IS:
         $7027.7

    DO YOU WANT TO RUN THE PROGRAM
AGAIN (Y/N)?
]LIST

1  HOME
10  PRINT  TAB( 5)"THIS IS A PROG
     RAM TO FIGURE THE"
15  PRINT "PRESENT VALUE OF AN IN
     TEREST TAX"
20  PRINT "DEDUCATION."
22  VTAB 10
23  INVERSE
24  HTAB 10: PRINT "DEMONSTRATION
      PROGRAM"
```

```
25  HTAB 9: PRINT "FOR EDUCATIONA
     L USE ONLY"
26  NORMAL
27  PRINT : PRINT : PRINT
28  PRINT  TAB( 5)"PRESS <RETURN>
     TO CONTINUE";: INPUT A$
29  HOME : PRINT : PRINT : PRINT

30  PRINT  TAB( 5)"WHAT IS THE TA
     X RATE, IN PERCENT";
40  INPUT T
50 T = T / 100
55  PRINT
60  PRINT  TAB( 5)"WHAT IS THE IN
     TEREST RATE, IN       PERCEN
     T";
70  INPUT K
80 K = K / 100
85  PRINT
90  PRINT  TAB( 5)"HOW MANY PERIO
     DS ARE THERE";
100  INPUT N
105  PRINT
110 P = 0
120  FOR J = 1 TO N
130  IF J > 1 THEN 160
140  PRINT  TAB( 5)"WHAT IS THE I
     NTEREST AMOUNT FOR"
150  GOTO 170
160  HTAB 10
170  PRINT " PERIOD ";J;" $";
180  INPUT Z
190 P = P + (Z * T) / ((1 + K) ^
     J)
200  NEXT J
210  HOME : PRINT : PRINT : PRINT

220  PRINT "THE PRESENT VALUE OF
     THE DEDUCTION IS:"
225  HTAB 10: PRINT "$"; INT (P *
     100 + .5) / 100
230  PRINT
240  PRINT  TAB( 5)"DO YOU WANT T
     O RUN THE PROGRAM"
245  PRINT "AGAIN (Y/N)?";
250  GET Z$
260  IF Z$ = "Y" THEN 20
270  IF Z$ <  > "N" THEN 240
280  END

]
```

The next program is "PRESENT VALUE OF INVESTMENT". This program will calculate the present value of all cash flows associated with an investment including the initial investment.

A sample problem for this program would be if you had an investment of $6,000 and you wanted a 15% interest return off the investement, but you got $10 per month over the next 2 years. If the program returns a positve number then your investment is good, if not you should reject it.

Here is a sample run to solve this problem and a listing of the program.

```
]RUN PRESENT VALUE OF INVESTMENT


    THIS IS A PROGRAM TO COMPUTE
THE PRESENT VALUE OF AN INVESTMENT.
         DEMONSTRATION PROGRAM
        FOR EDUCATIONAL USE ONLY



    PRESS <RETURN> TO CONTINUE?




    ENTER THE AMOUNT INVESTED?6000
THE NUMBER OF YEARS IT HAS BEEN INVESTED?2
    WHAT PERCENT RATE OF RETURN DO YOU
WANT?15

ENTER CASH FLOW AMOUNTS EACH YEAR
(ENTER OVERFLOWS AS NEGATIVE).

INFLOW FOR YEAR 1 ?120
                2 ?120

NET PRESENT VALUE = $ -5804.91

    DO YOU WANT TO RUN THIS PROGRAM
AGAIN (Y/N)?
]LIST

5  HOME : PRINT : PRINT : PRINT
10  PRINT  TAB( 5)"THIS IS A PROG
     RAM TO COMPUTE"
15  PRINT "THE PRESENT VALUE OF A
     N INVESTMENT."
16  VTAB 10
17  INVERSE
18  HTAB 10: PRINT "DEMONSTRATION
      PROGRAM"
19  HTAB 9: PRINT "FOR EDUCATIONA
     L USE ONLY"
20  NORMAL
21  PRINT : PRINT : PRINT
22  PRINT  TAB( 5)"PRESS <RETURN>
      TO CONTINUE";: INPUT A$
23  HOME : PRINT : PRINT : PRINT

29  DEF  FN A(X) =  INT (X * 100 +
     .5) / 100
30  REM ADD DIM C(N) STATEMENT
35  REM AT LINE 40
36  REM IF MAXIMUM NUMBER OF CASH

37  REM FLOWS IS > 10
40  REM
```

```
50  PRINT
60  PRINT  TAB( 5)"ENTER THE AMOU
     NT INVESTED";
70  INPUT CO
80 CO =  -  FN A(CO)
90  PRINT "THE NUMBER OF YEARS IT
      HAS BEEN INVESTED";
100  INPUT N
110  PRINT  TAB( 5)"WHAT PERCENT
     RATE OF RETURN DO YOU"
120  PRINT "WANT";: INPUT R
130 R = R / 100 + 1
140 F = 0
150  PRINT
160  PRINT "ENTER CASH FLOW AMOUN
     TS EACH YEAR"
170  PRINT "(ENTER OVERFLOWS AS N
     EGATIVE)."
175  PRINT
180  FOR J = 1 TO N
190  IF J > 1 THEN 220
200  PRINT "INFLOW FOR YEAR ";
210  GOTO 230
220  PRINT "                 ";
230  PRINT J;" ";
240  INPUT C(J)
260  NEXT J
270 T = CO
280  REM ADD PRESENT VALUES FOR
281  REM EACH YEAR BASED ON RATE
282  REM OF R
290  FOR J = 1 TO N
300 T = T +  FN A(C(J) / (R ^ J))

310  NEXT J
320  PRINT
330  PRINT "NET PRESENT VALUE = $
      "; FN A(T)
340  REM  RESTART END OF PROGRAM
350  PRINT
360  PRINT  TAB( 5)"DO YOU WANT T
     O RUN THIS PROGRAM"
365  PRINT "AGAIN (Y/N)?";
370  GET A$
375  HOME
380  IF A$ = "Y" GOTO 50
390  IF A$ = "N" THEN 400
395 : PRINT : PRINT : PRINT  TAB(
     5)"ILLEGAL ENTRY, TRY AGAIN.
     ": PRINT : PRINT :
396  GOTO 360
400  END

]
```

The next program is "FUTURE VALUE OF INVESTMENT". This program will compute the number of all cash flows to and from an investment.

A sample problem would be if you were going to invest $500 in a chicken ranch which would return 14% interest per-quater, but you had to by $2 of feed per month, would over a period of two years would you come out ahead. You must enter the initial investment, the $500. the number of cash flows counting this investment would be 25, but only the 500 will be positive, since you did not increase your investment.

Here is a run of the program to solve this problem, and a program listing.

```
RUN FUTURE VALUE OF INVESTMENT


    THIS IS A PROGRAM TO FIGURE THE
FUTURE VALUE OF AN INVESTMENT.
         DEMONSTRATION PROGRAM
        FOR EDUCATIONAL USE ONLY



    PRESS <RETURN> TO CONTINUE?



    HOW MANY CASH FLOWS ARE THERE?25

WHAT IS THE GROWTH RATE, IN PERCENT?14

(ENTER INFLOWS AS POSITIVE,
 OUTFLOWS AS NEGATIVE)
AMOUNT OF CASH FLOW 1 ?500
                    2 ?-2
                    3 ?-2
                    4 ?-2
                    5 ?-2
                    6 ?-2
                    7 ?-2
                    8 ?-2
                    9 ?-2
                    10 ?-2
                    11 ?-2
                    12 ?-2
                    13 ?-2
                    14 ?-2
                    15 ?-2
                    16 ?-2
                    17 ?-2
                    18 ?-2
                    19 ?-2
                    20 ?-2
                    21 ?-2
                    22 ?-2
                    23 ?-2
                    24 ?-2
                    25 ?-2

    THE FUTURE VALUE AT THE END OF 25
PERIODS WILL BE $11288.8

    DO YOU WANT TO RUN THE PROGRAM
AGAIN (Y/N)?
]LIST

5  HOME : PRINT : PRINT : PRINT
10  PRINT  TAB( 5)"THIS IS A PROG
    RAM TO FIGURE THE"
15  PRINT "FUTURE VALUE OF AN INV
```

```
    ESTMENT."
16  VTAB 10: INVERSE
17  HTAB 10: PRINT "DEMONSTRATION
      PROGRAM"
18  HTAB 9: PRINT "FOR EDUCATIONA
     L USE ONLY"
19  NORMAL : PRINT : PRINT : PRINT

20  PRINT  TAB( 5)"PRESS <RETURN>
      TO CONTINUE";: INPUT A$
22  HOME : PRINT : PRINT : PRINT

29  DEF  FN A(X) =  INT (X * 100 +
     .5) / 100
30  PRINT
40  PRINT  TAB( 5)"HOW MANY CASH
     FLOWS ARE THERE";
50  INPUT N
55  PRINT
60  PRINT "WHAT IS THE GROWTH RAT
     E, IN PERCENT";
70  INPUT R
80 R = R / 100
90  PRINT
100 T = 0
110  PRINT "(ENTER INFLOWS AS POS
     ITIVE,"
115  PRINT " OUTFLOWS AS NEGATIVE
     )"
120  FOR J = 1 TO N
130  IF J > 1 THEN 160
140  PRINT "AMOUNT OF CASH FLOW "
     ;
150  GOTO 170
160  HTAB 21
170  PRINT J;" ";
180  INPUT C
190  REM ADD FUTURE VALUE OF EACH

192  REM YEAR BASED ON RATE OF R
200 T = T +  FN A(C * (1 + R) ^ (
     N - J))
210  NEXT J
220  PRINT
230  PRINT  TAB( 5)"THE FUTURE VA
     LUE AT THE END OF ";N
235  PRINT "PERIODS WILL BE $";T
240  REM RESTART OF END PROGRAM?
250  PRINT
260  PRINT  TAB( 5)"DO YOU WANT T
     O RUN THE PROGRAM"
265  PRINT "AGAIN (Y/N)?";
270  GET Z$
280  IF Z$ = "Y" THEN 30
290  IF Z$ = "N" THEN 300
295  PRINT : PRINT : PRINT "ILLEG
     AL ENTRY, TRY AGAIN.": PRINT
     : PRINT : PRINT
300  END
```

The next program is "DEPRECIATION SWITCH". This program to determine when to switch from an accelerated depreciation to a straight line depreciation in order to obtain the largest possible amount of depreciation in both the earlier and later years.

A sample problem for this program would be if you buy an item that has a useful life of 7 years, and you plan to use 200% declining balance depreciation. If you are into the 3rd month of the first year, when should you switch to stright line depreciation in order to maximise the depreciation.

Here is a sample run to solve that problem, and a listing of the program.

```
]RUN DEPRECIATION SWITCH


    THIS IS A PROGRAM TO COMPUTE
DEPRECIATION.
         DEMONSTRATION PROGRAM
        FOR EDUCATIONAL USE ONLY



    PRESS <RETURN> TO CONTINUE?



WHAT PERCENT ACCELERATED DEPRECIATION
DO YOU WANT TO USE?200



    WHAT IS THE USEFUL LIFE OF THE
ASSET IN YEARS?7



    HOW MANY MONTHS ARE LEFT IN
THE FIRST YEAR?9




    YOU SHOULD SWITCH IN THE 5TH YEAR.

    DO YOU WANT TO DO ANOTHER (Y/N)?

]LIST

5  HOME : PRINT : PRINT : PRINT
10  PRINT  TAB( 5)"THIS IS A PROG
     RAM TO COMPUTE"
15  PRINT "DEPRECIATION."
16  VTAB 10
17  INVERSE
18  HTAB 10: PRINT "DEMONSTRATION
      PROGRAM"
19  HTAB 9: PRINT "FOR EDUCATIONA
     L USE ONLY"
20  NORMAL
21  PRINT : PRINT : PRINT
22  PRINT  TAB( 5)"PRESS <RETURN>
      TO CONTINUE";: INPUT A$
```

```
23  HOME : PRINT : PRINT : PRINT

29  REM USE MILLON DOLLAR COST
30  REM TO SEPARATE CLOSE
35  REM CALCULATIONS.
40 C = 1E + 6
50  REM RESET AUMULATION
55  REM DEPRECIATION TO ZERO.
60 A = 0
70  PRINT
80  PRINT "WHAT PERCENT ACCELERAT
     ED DEPRECIATION"
85  PRINT "DO YOU WANT TO USE";
90  INPUT T
100  PRINT : PRINT : PRINT
110 T = T / 100
120  PRINT  TAB( 5)"WHAT IS THE U
     SEFUL LIFE OF THE"
125  PRINT "ASSET IN YEARS";
130  INPUT L
135  PRINT : PRINT : PRINT
140  IF L > 3 THEN 170
150  PRINT  TAB( 5)"3 YEARS MIN.
     TRY AGAIN."
160  PRINT : PRINT : PRINT : GOTO
     120
170  PRINT  TAB( 5)"HOW MANY MONT
     HS ARE LEFT IN"
175  PRINT "THE FIRST YEAR";
180  INPUT M
185  PRINT : PRINT : PRINT
190 Y = 1
200  REM CALCULATE DEPRECIATION
201  REM ACCUMULATED IN THE 1ST
202  REM YEAR.
210 A =  INT (((M / 12) * (T / L)
      * C) * 100 + .5) / 100
220 Y = Y + 1
230  REM COMPUTE AMOUNT OF
231  REM DEPRECIATION THIS YEAR.
240 D =  INT (((T / L) * (C - A))
      * 100 + .5) / 100
250  REM IF DEPRECIATION IS
251  REM LESS THAN VALUE
252  REM DIVIDED BY REMAINING
253  REM LIFE, PRINT YEAR NUMBER.

270  IF D < (C - A) / (L - Y + 1 +
     (12 - M) / 12) THEN 310
280  REM IF NOT INCREMENT
281  REM ACCUMULATED DEPRECIATION
     .
290 A = A + D
```

```
300  GOTO 220
310  PRINT
320  PRINT  TAB( 5)"YOU SHOULD SW
     ITCH IN THE ";Y;"TH YEAR."
330  PRINT
340  PRINT  TAB( 5)"DO YOU WANT T
     O DO ANOTHER (Y/N)?";: GET A
     $: PRINT
350  IF A$ = "Y" THEN  PRINT : PRINT
     : PRINT : GOTO 60
360  END

]
```

The next program is "INTERNAL RATE OF RETURN". This program finds the rate at which all cash flows discount to the amount of the initial investment. to use this program enter the amount of the initial investment, the term of the investment, and the cash flows. For example, say you have an investment of $5,000 with returns of $600, $800, $1,200, and $600 over the next four terms. enter this to the program. The program will output the % of return on your loan over the four terms.

Here is a sample run and listing of the program.

```
RUN INTERNAL RATE OF RETURN


    THIS IS A PROGRAM TO FIGURE THE
INTERNAL RATE OF RETURN ON AN
INVESTMENT. IT WILL KEEP RUNNING UNTILL
0 IS INPUT AS THE INITIAL INVESTMENT.
         DEMONSTRATION PROGRAM
        FOR EDUCATIONAL USE ONLY



    PRESS <RETURN> TO CONTINUE?



    WHAT IS YOUR INITIAL INVESTMENT $?50000

    HOW MANY CASH FLOWS ARE THERE?4

(ENTER INFLOWS AS POSITIVE,
 OUTFLOWS AS NEGATIVE)
CASH FLOW 1 ?600
          2 ?800
          3 ?1200
          4 ?600


YOUR INTERNAL RATE OF RETURN IS 50%.

    DO YOU WANT TO DO ANOTHER (Y/N)?

]LIST

5  HOME : PRINT : PRINT : PRINT
10  PRINT  TAB( 5)"THIS IS A PROG
     RAM TO FIGURE THE"
15  PRINT "INTERNAL RATE OF RETUR
     N ON AN"
16  PRINT "INVESTMENT. IT WILL KE
     EP RUNNING UNTILL"
17  PRINT "0 IS INPUT AS THE INIT
     IAL INVESTMENT."
20  REM FUNCTION TO ROUND
21  REM TO NEAREST HUNDERTH.
30  DEF  FN A(X) =  INT (X * 100 +
     .5) / 100
40  REM FUNCTION TO ROUND TO
41  REM NEAREST TEN-THOUSANDTH.
50  DEF  FN B(X) =  INT (X * 1E4 +
     .5) / 1E4
60  REM CHANGE SIZE OF ARRAY
61  REM C() IF NECESSARY.
70  DIM C(12)
71  VTAB 10
72  INVERSE
73  HTAB 10: PRINT "DEMONSTRATION
      PROGRAM"
```

```
74  HTAB 9: PRINT "FOR EDUCATIONA
     L USE ONLY"
75  NORMAL
76  PRINT : PRINT : PRINT
77  PRINT  TAB( 5)"PRESS <RETURN>
      TO CONTINUE";: INPUT A$
78  HOME : PRINT : PRINT : PRINT

90  PRINT  TAB( 5)"WHAT IS YOUR I
     NITIAL INVESTMENT $";
100  INPUT I
110  REM  END PROGRAM
120  IF I = 0 THEN 590
130  PRINT
140  PRINT  TAB( 5)"HOW MANY CASH
      FLOWS ARE THERE";
150  INPUT N
160  REM  RESTART IF # OF CASH
161  REM FLOW PERIODS IS INVALID.

170  IF N < 1 THEN 80
180  REM LOOP INPUT AND SUM
181  REM CASH FLOW AMOUNTS.
190 F = 0
200  PRINT
210  PRINT "(ENTER INFLOWS AS POS
     ITIVE,
215  PRINT " OUTFLOWS AS NEGATIVE
     )
220  FOR J = 1 TO N
230  IF J > 1 THEN 260
240  PRINT "CASH FLOW ";
250  GOTO 270
260  HTAB 11
270  PRINT J;" ";
280  INPUT C(J)
300  NEXT J
310  PRINT
320  REM INITIALIZE VALUES
330 L = 0
340 H = 1
350 R1 = 0
360  REM GUESS RATE=(HIGH
361  REM RATE+LOW RATE)/2
370 R = (L + H) / 2
380  REM EXIT IF RATE REMAINS
381  REM UNCHANGED.
390  IF R = R1 THEN 550
400  REM SET LAST GUESS TO
401  REM TO CURRENT GUESS.
410 R1 = R
420  REM ADD PRESENT VALUES
421  REM FOR EACH YEAR BASED
422  REM RATE OF.
430 T = 0
440  FOR J = 1 TO N
450 T = T +  FN A(C(J) / ((R + 1)
     ^ J))
460  NEXT J
```

```
470  REM IF TOTAL PRESENT
471  REM VALUES EQUAL INVESTMENT,

472  REM EXIT.
480  IF T = I THEN 550
490  REM SET HIGH OF LOW
491  REM RATE TOCURRENT GUESS.
500  IF I > T THEN 530
510 L = R
520  GOTO 370
530 H = R
550  PRINT
560  PRINT "YOUR INTERNAL RATE OF
      RETURN IS " FN B(R * 100);"
     %."
570  PRINT
580  PRINT  TAB( 5)"DO YOU WANT T
     O DO ANOTHER (Y/N)?";
590  GET A$: PRINT
600  IF A$ = "Y" THEN  HOME : PRINT
     : PRINT : PRINT : GOTO 90

]
```

The next program is "MORTGAGE AMORTIZATION". This program will calculate and output a loan repayment schedule. For instance, suppose you make a loan with a friend of $700.00 at 9% interest. Further suppose you plan to pay your friend back over the next eight months at $100 a month. This program will print you a repayment schedule given this information.

Here is a sample run and listing of the program.

```
RUN MORTGAGE AMORTIZATION
      MORTGAGE AMORTIZATION TABLE


    THIS PROGRAN WILL PRINTOUT
A MORTGAGE AMORTIZATION TABLE.
         DEMONSTRATION PROGRAM
        FOR EDUCATIONAL USE ONLY



    PRESS <RETURN> TO CONTINUE?
    WHAT WILL THE PAYMENTS BE?100
    HOW IS THE TERM IN YEARS & MONTHS
         YEARS   ?0
         MONTHS  ?8
    WHAT IS THE PRINCIPLE?700
    WHAT IS THE ANNUAL INTEREST RATE,
IN PERCENT?9
    HOW MANY PAYMENTS PER YEAR?12
    WHAT YEAR DO YOU WANT TO START
THE CHART FROM?1
PRINCIPAL $700 AT 9 %
FOR 0 YEARS & 8 MONTHS
WITH REGULAR PAYMENTS OF $100
NO.  INTEREST AMORTIZED BALANCE ACCUM.IN
1    5.25     94.75     605.25  5.25
2    4.54     95.46     509.79  9.79
3    3.82     96.18     413.61  13.61
4    3.1      96.9      316.71  16.71
5    2.38     97.62     219.09  19.09
6    1.64     98.36     120.73  20.73
7    .91      99.09     21.64   21.64
8    .16      21.64     0       21.8

***LAST PAYMENT = $21.8

YR 1 21.8     700

RECOMPUTE WITH NEW DATA (Y/N)N

]LIST

1  REM DEFINE ROUND OFF
2  REM FUNCTION.
5  DEF  FN R(X) =  INT (X * 100 +
     .5) / 100
6  TEXT : HOME : PRINT  TAB( 7)"M
     ORTGAGE AMORTIZATION TABLE"
7  REM SET TEXT WINDOW
8  REM TO LINES 2 TO 24
9  POKE 34,1: PRINT
```

```
10  PRINT : PRINT : PRINT  TAB( 5
     )"THIS PROGRAN WILL PRINTOUT
     "
11  PRINT "A MORTGAGE AMORTIZATIO
     N TABLE."
12  VTAB 10
13  INVERSE
14  HTAB 10: PRINT "DEMONSTRATION
      PROGRAM"
15  HTAB 9: PRINT "FOR EDUCATIONA
     L USE ONLY"
16  NORMAL
17  PRINT : PRINT : PRINT
18  PRINT  TAB( 5)"PRESS <RETURN>
      TO CONTINUE";: INPUT A$
19  HOME
22  REM STATEMENTS 30 TO
23  REM 140 REQUIRE USER INPUT.
30  PRINT  TAB( 5)"WHAT WILL THE
     PAYMENTS BE";: INPUT R
40  PRINT  TAB( 5)"HOW IS THE TER
     M IN YEARS & MONTHS"
45  HTAB 10: PRINT "YEARS   ";: INPUT
     YO
50  HTAB 10: PRINT "MONTHS  ";: INPUT
     M
64  REM CALCULATE YEARS FROM
65  REM YEARS AND MONTHS.
66 Y = (12 * YO + M) / 12
70  PRINT  TAB( 5)"WHAT IS THE PR
     INCIPLE";: INPUT P
80  PRINT  TAB( 5)"WHAT IS THE AN
     NUAL INTEREST RATE,"
90  PRINT "IN PERCENT";: INPUT I
105  REM CONVERT FROM PERCENT
106  REM TO DECIMAL.
110 I = I / 100
120  PRINT  TAB( 5)"HOW MANY PAYM
     ENTS PER YEAR";: INPUT N
140  PRINT  TAB( 5)"WHAT YEAR DO
     YOU WANT TO START"
150  PRINT "THE CHART FROM";: INPUT
     X
155  REM START PRINTING AT
156  REM BEGINNING OF YEAR.
160 X =  INT (X)
165  REM INITIALIZE VARIABLES.
170 C1 = 0
180 I2 = 0
190 I3 = 0
200 JO = 0
210 N1 = N
220 BO = P
```

```
230 A1 = 0
240 A2 = 0
255  REM PRINT INFORMATION
256  REM THAT DOSENT CHANGE
257  REM ON THE SCREEN.
260  HOME : PRINT "PRINCIPAL $";P
     ;" AT ";I * 100;" %"
270  PRINT "FOR ";YO;" YEARS & ";
     M;" MONTHS"
280  PRINT "WITH REGULAR PAYMENTS
      OF $";R
290  VTAB 5: PRINT "NO.";: HTAB 6
     : PRINT "INTEREST";: HTAB 15
     : PRINT "AMORTIZED";: HTAB 2
     5: PRINT "BALANCE";: HTAB 33
     : PRINT "ACCUM.IN"
295  REM SET TEXT WINDOW TO
296  REM LINES 6 TO 24
300  POKE 34,5: HOME
309  REM SET LINE COUNTER.
310 CT = 6
315  REM TERMS LESS THAN 1 YR?
320  IF  INT (Y) >  = 1 THEN 360
325  REM ADJUST VARIABLE TO
326  REM PRINT A PARTIAL YEAR.
330 N1 = ((Y -  INT (Y)) * 12) /
     12 * N
340 JO = JO + 1: GOTO 410
359  REM LOOPFOR EACH YEAR.
360  FOR JO = 1 TO  INT (Y)
410  FOR J1 = 1 TO N1
415  REM CALCULATE INTEREST PAID
416  REM THIS PAYMENT, ROUND OFF
420 I1 =  INT ((BO * I / N) * 100
      + .5) / 100
425  REM COUNT # OF PAYMENTS
426  REM MADE SO FAR.
430 C1 = C1 + 1
435  REM CALCULATE AMOUNT
436  REM AMORTIZED THIS
437  REM PAYMENT.
440 A = R - I1
445  REM SUM AMOUNT AMORTIZED
446  REM TO DATE.
450 A1 = A1 + A
455  REM CALCULATE BALANCE DUE.
460 BO = P - A1
465  REM LAST PAYMENT? IF YES
466  REM CALCULATE AMOUNT SO
467  REM THAT THE BALANCE
468  REM DUE=0.00 AFTER THIS
469  REM PAYMENT.
470  IF C1 <  > N * Y THEN 520
```

```
480 R = R + BO
490 A = A + BO
500 A1 = A1 + BO
510 BO = 0
515  REM SUM INTEREST PAID
516  REM TO DATE.
520 I2 = I2 + I1
525  REM SUM INTEREST PAID
526  REM THIS YEAR.
530 I3 = I3 + I1
535  REM SUM AMOUNT AMORTIZED
536  REM THIS YEAR.
540 A2 = A2 + A
545 A2 =  INT (A2 * 100 + .5) / 1
     00
546  REM STARTED PRINTING?
547  REM IF YES, PRINT COMPUTED
548  REM VALUES IN TABLE.
550  IF JO < X THEN 570
555  REM ROUND OFF THEN PRINT.
560  PRINT J1;: HTAB 6: PRINT  FN
     R(I1);: HTAB 15: PRINT  FN R
     (A);: HTAB 25: PRINT  FN R(B
     O);: HTAB 33: PRINT  FN R(I2
     ):CT = CT + 1: GOSUB 800
570  NEXT J1
575  REM LAST PAYMENT? IF YES
576  REM ROUND OFF & PRINT.
580  IF C1 <  > N * Y THEN 600
590  PRINT : PRINT "***LAST PAYME
     NT = $";( INT (R * 100 + .5)
     ) / 100
595  REM STARTED PRINTING?
596  REM IF YES, PRINT
597  REM YEARLY TOTALS.
600  IF JO < X THEN 640
615  REM ROUND OFF AND PRINT.
620  PRINT : PRINT "YR ";JO;: HTAB
     6: PRINT  FN R(I3);: HTAB 15
     : PRINT  FN R(A2)
625  PRINT :CT = CT + 2: GOSUB 80
     0
626  REM COMPLETED TEST?
640  IF JO > Y THEN 730
645  REM REINITIALIZE YEARLY
646  REM VARIABLES.
650 I3 = 0
660 A2 = 0
670  NEXT JO
671 JO = JO - 1
675  REM NEED TO PRINT A
676  REM PARTIAL YEAR.
680  IF Y <  > JO THEN 330
```

```
729  REM RESTART OR END PROGRAM
730  VTAB 23: INPUT "RECOMPUTE WI
     TH NEW DATA (Y/N)";Z$
735  TEXT : POKE 34,1
740  IF Z$ = "Y" GOTO 19
750  TEXT : END
795  REM PAUSE AND WAIT FOR
796  REM USER RESPONSE?
800  IF CT < 20 THEN  RETURN
810  VTAB 23: INPUT "PRESS <RETUR
     N> TO CONTINUE ";Z$: HOME :C
     T = 6: RETURN

]
```

The next program is "PRODUCTION AND DISTRUBUTION". This program will tell you the best possible combinations of producers with distributors with regard to transportation cost.

For axample, say you have three shops each rebuilding engines. and you have 2 distributors that sale and install the engines. the first shop can build 5 engines per week, the second can build 3 and the third only 2. now the first distributor can sale and install 6 engines per week, and the second can sale and install 5. Suppose it cost $40 to take one engine from shop 1 to distributor 1, and $60 to go from shop 1 to distributor 2. While it only requires $30 dallors to go from shop 2 to dist. 2, but $90 to go from shop 2 to dist. 1.→It takes $45 to go from shop 3 to dist. 1 and $40 to go from shop 3 to dist 2. If you enter these values into the program it will tell you the cheepest combinations of shops to dist.

Here is a sample run and listing of the program.

```
RUN PRODUCTION AND DISTRUBUTION


    THIS IS A PROGRAM TO GIVE THE BEST
POSSIBLE COMBINATION OF PRODUCERS TO
DISTRIBUTORS.
         DEMONSTRATION PROGRAM
        FOR EDUCATIONAL USE ONLY



    PRESS <RETURN> TO CONTINUE?



HOW MANY PRODUCERS ARE THERE?3
HOW MANY DISTRIBUTORS?2
CAPABILITY OF PRODUCER 1 ?5
CAPABILITY OF PRODUCER 2 ?3
CAPABILITY OF PRODUCER 3 ?2
OUTPUT FROM DISTRIBUTOR 1 ?6
OUTPUT FROM DISTRIBUTOR 2 ?5
TRANSPORTATION COST:
FROM PRODUCER 1 TO DISTRIBUTOR 1 ?40
FROM PRODUCER 1 TO DISTRIBUTOR 2 ?60
FROM PRODUCER 2 TO DISTRIBUTOR 1 ?90
FROM PRODUCER 2 TO DISTRIBUTOR 2 ?30
FROM PRODUCER 3 TO DISTRIBUTOR 1 ?45
FROM PRODUCER 3 TO DISTRIBUTOR 2 ?40

PRODUCER DIST. # ITEMS COST TOTAL
1        1     5        40   200
2        2     3        30   90
3        1     1        45   45
3        2     1        40   40

TOTAL COST OF SOLUTION: 375


    DO YOU WANT TO RUN THIS PROGRAM
AGAIN (Y/N)?

]LIST

5  HOME : PRINT : PRINT : PRINT
10  REM PRODUCTION AND DISTRIBUTI
     ON
20  DIM P(10,2),D(10,2),P1(20,2),
     C(10,10)
30  DIM A(10,10),Y(19,2),M(3),R1(
     10),K1(10)
40  PRINT  TAB( 5)"THIS IS A PROG
     RAM TO GIVE THE BEST"
42  PRINT "POSSIBLE COMBINATION O
     F PRODUCERS TO"
44  PRINT "DISTRIBUTORS."
45  VTAB 10
46  INVERSE
```

```
                S T A I R   C A L C U L A T O R

  FLOOR TO FLOOR DISTANCE IN INCHES ........... ? 98
  STAIR RUN IN INCHES ......................... ? 124
  ENTER NUMBER OF RISERS DESIRED .............. ? 13
  NO. OF TREADS (ALWAYS 1 LESS THAN RISERS).... ? 12


         RISER HEIGHT = ........................... 7.53846    INCHES
         TREAD WIDTH = ............................ 10.3333    INCHES
                                                   ---------------

           RISER + TREAD EQUAL ..............      17.8718    INCHES


 THE COMBINED RISE AND RUN SHOULD BE AS CLOSE TO  17.5  INCHES
 AS POSSIBLE.

   DO YOU WANT ANOTHER CALCULATION ? (1=YES, 2=NO)? ^C
Break in 250
Ready
>SYSTEM"SCREEN




10 CLS
20 PRINT"                S T A I R   C A L C U L A T O R"
30 PRINT
40 REM                   MYCUE  -  1983
50 PRINT
60 INPUT"  FLOOR TO FLOOR DISTANCE IN INCHES ........... ";F
70 INPUT"  STAIR RUN IN INCHES ......................... ";R
80 INPUT"  ENTER NUMBER OF RISERS DESIRED ..............  ";NR
90 INPUT"  NO. OF TREADS (ALWAYS 1 LESS THAN RISERS).... ";NT
100 TW=R/NT       'TREAD WIDTH=RUN/NO. OF TREADS
110 RI=F/NR       'RISER HEIGHT=FLOOR TO FLOOR HT./NO. OF RISERS
120 R=NT*TW       'RUN=NO. OF TREADS TIMES TREAD WIDTH
130 RT=RI+TW      'RISER HEIGHT + TREAD WIDTH
140 PRINT:PRINT
150 PRINT"      RISER HEIGHT = ...........................";RI;"   INCHES
160 PRINT"      TREAD WIDTH = ............................";TW;"   INCHES
170 PRINT"                                                ---------------"
180 PRINT
190 PRINT"          RISER + TREAD EQUAL ..............     ";RT;"   INCHES
200 PRINT
210 PRINT
220 PRINT" THE COMBINED RISE AND RUN SHOULD BE AS CLOSE TO  17.5  INCHES
230 PRINT" AS POSSIBLE.
240 PRINT
250 INPUT"   DO YOU WANT ANOTHER CALCULATION ? (1=YES, 2=NO)";FF
260 IF FF=1 THEN 10
270 IF FF=2 THEN END
```

```
10 '      THIS IS A PROGRAM FOR THE STUDENT OF CARPENTRY,
20 ' ESTIMATING, AND ARCHITECTURAL DRAFTING. IT WOULD BE
30 ' PREFERABLE IF THE STUDENT HAD KNOWLEADGE OF THE TERMS
40 ' RISE, RUN, SPAN, RIDGEBOARD, OVERHANG, AND RAFTER AS
50 ' THEY PRETAIN TO ROOF FRAMING.
60 '
70 ' THIS PROGRAM IS USED TO COMPUTE THE LENGTH OF A COMMAN
80 ' RAFTER ON A BUILDING. IT WILL BE NECESSARY TO KNOW OR
90 ' HAVE ON HAND THE SPAN DIMENSION PER FOOT OF RUN, THE
100 ' ROOF OVERHANG LENGTH, AND THE RIDGEBOARD THICKNESS
110 ' IF THERE IS A RIDGEBOARD.
260 '
270 '
280 T2=2
290 L2=0
300 '
310 '
320 '      FIGURE THE LENGTH OF THE COMMAN RAFTER.
330 '
340 '
360 PRINTTAB(5)"TO USE THIS PROGRAM YOU WILL NEED TO HAVE THE"
370 PRINT"FOLLOWING DATA.":PRINT
380 PRINTTAB(5)"RAFTER SLOPE, RUN(1/2 SPAN), OVERHANG, THICKNESS"
390 PRINT"OF THE RIDGEBOARD.":PRINT
400 PRINTTAB(5)"IF YOU NEED THESE FIGURES PRESS THE <BREAK> KEY"
410 PRINT"AND OBTAIN THEM."
420 PRINT
430 PRINTTAB(5)"FIRST TYPE IN YOUR RISE FOR ONE FOOT OF RUN."
440 PRINT"IN INCHES";:INPUT A
450 PRINT:PRINT:PRINT
460 '
470 '      A - IS EQUAL TO THE ALTITUDE OR RISE OF THE SLOPE.
480 '
490 '      H - IS EQUAL TO THE HYPOTENUSE OF THE SLOPE.
500 '
510 '      L - THE LENGTH OF THE RUN.
520 '
550 H=(A[2)+144
560 PRINTTAB(5)"WHAT IS THE RUN (1/2 SPAN), IN FEET AND INCHES."
570 PRINTTAB(10)"FEET: ";:INPUT R1
580 PRINTTAB(10)"INCHES: ";:INPUT R3
590 R3=R3/12
600 R1=R1+R3
610 PRINT:PRINT:PRINT
620 '
630 ' L1 - THE RAFTER LENGTH.
640 '
650 L1=(SQR (H))*R1
660 PRINTTAB(5)"IS THERE AN OVERHANG? (Y/N)";
665 A$=""
670 A$=INKEY$:IF A$="" THEN 670
680 PRINT:PRINT:PRINT
690 IF A$ = "Y" THEN 730
700 IF A$ = "N" THEN 740
```

```
710 PRINTTAB(5)"ILLEAGLE ENTRY, PLEASE TRY AGAIN.":PRINT:PRINT:PRINT
720 GOTO 660
730 GOSUB 930
740 PRINTTAB(5)"IS THERE A RIDGEBOARD? (Y/N)";:B$=""
750 B$=INKEY$:IF B$="" THEN 750
760 PRINT:PRINT:PRINT
770 IF B$ = "Y" THEN 810
780 IF B$ = "N" THEN 820
790 PRINTTAB(5)"ILLEAGLE ENTRY, PLEASE TRY AGAIN.":PRINT:PRINT:PRINT
800 GOTO740
810 GOSUB 1000
820 L3=L1+L2-T2
830 L3=L3/12
840 PRINTTAB(5)"THE LENGTH OF THE RAFTER WILL BE ";INT(L3);" FEET"
850 PRINT"AND ";(L3-INT(L3))*12;" INCHES.":PRINT:PRINT:PRINT
860 PRINTTAB(5)"ARE THERE ANY MORE RAFTERS TO BE COMPUTED? (Y/N)";
865 C$=""
870 C$=INKEY$:IF C$="" THEN 870
875 PRINT:PRINT:PRINT
880 IF C$="Y" THEN 430
890 IF C$="N" THEN 920
900 PRINTTAB(5)"ILLEAGLE ENTRY, PLEASE TRY AGAIN.":PRINT:PRINT:PRINT
910 GOTO 860
920 END
930 PRINTTAB(5)"GIVE THE OVERHANG DIMENSIONS IN FEET AND INCHES."
940 PRINTTAB(10)"FEET: ";:INPUT O
950 PRINTTAB(10)"INCHES: ";:INPUT O3
955 O3=O3/12
960 O=O+O3
970 PRINT:PRINT:PRINT
980 L2=O*(SQR(H))
990 RETURN
1000 PRINTTAB(5)"GIVE THE THICKNESS OF THE RIDGEBOARD IN INCHES:
     ";:INPUT T
1010 T=T/12
1020 T2=T/12
1030 RETURN
```

```
10 '      THIS IS A PROGRAM DESIGNED TO GET THE I.A.
20 ' STUDENT USED TO USING THE COMPUTER TO AID HIM
30 ' WITH HIS PROJECTS.
40 '
50 '      THIS PROGRAM WILL DETERMINE THE ACTUAL
60 ' NUMBER OF CUBED UNITS IN A SINGLE BOARD. THE
70 ' STUDENT WILL ENTER THE UNITS HE IS WORKING WITH
80 ' I.E. INCHES, FEET, METERS...
90 '
100 '      THIS PROGRAM WILL ALSO CALCULATE SQUARE BOARD
110 ' UNITS IN A PROJECT, AND TOTAL COST OF A PROJECT,
120 ' GIVEN THE TOTAL SURFACE AREA OF A PROJECT (BOARD
130 ' SURFACE), AND THE PRICE PER EITHER BOARDS OR UNITS.
140 '
150 '
210 PRINTTAB(5)"***************BOARD UNITS***************"
215 PRINT:PRINT:PRINT
220 PRINTTAB(10)"DETERMINING BOARD UNITS KNOWING THICKNESS, WIDTH,"
225 PRINTTAB(5)"AND LENGTH."
230 PRINT:PRINT:PRINT:PRINT
240 PRINTTAB(5)"WHAT UINTS ARE YOU WORKING WITH";:INPUT A$
250 PRINTTAB(5)"HOW MANY ";A$;" THICK IS THE BOARD";:INPUT T
260 PRINT:PRINT:PRINT
270 PRINTTAB(5)"HOW MANY ";A$;" WIDE IS THE BOARD";:INPUT W:PRINT:PRINT:PRINT
280 PRINTTAB(5)"HOW MANY ";A$;" LONG IS THE BOARD";:INPUT L:PRINT:PRINT:PRINT
290 B=T*W*L
300 PRINTTAB(5)"THE VOLUME OF ONE BOARD IS ";B;" CUBED ";A$;"."
310 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
330 PRINTTAB(5)"DO YOU WANT TO CALCULATE THE TOTAL COST OF A"
340 PRINT"PROJECT? TYPE 'Y' OR 'N' (Y/N)";
350 C$=""
355 C$=INKEY$:IFC$=""THEN355
360 IFC$="Y" THEN 380
365 IF C$="N" THEN 1000
369 PRINT:PRINT:PRINT
370 PRINTTAB(5)"ILLEAGLE ENTRY, PLEASE TRY AGAIN.":PRINT:PRINT:PRINT
375 GOTO330
380 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
390 PRINTTAB(5)"WOULD YOU LIKE TO FIHURE THE PRICE OF A PROJECT BY...":PRINT
400 PRINTTAB(10)"A. THE TOTAL NUMBER OF ";A$;" IN THE PROJECT?"
410 PRINTTAB(10)"B. THE TOTAL NUMBER OF BOARDS IN THE PROJECT?":PRINT
420 PRINTTAB(5)"TYPE (A/B)"
430 C$=INKEY$:IFC$="" THEN 430
435 IF C$="A" THEN 470
440 IF C$="B" THEN 590
445 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
450 PRINTTAB(5)"ILLEAGLE ENTRY, PLEASE TRY AGAIN.":PRINT:PRINT:PRINT
460 GOTO 390
470 PRINTTAB(5)"WHAT IS THE COST OF A SINGLE BOARD IN DOLLARS";:INPUT X
480 PRINTTAB(5)"HOW MANY SQUARE ";A$;" ARE IN THE SURFACE AREA"
490 PRINT"OF THE PROJECT";:INPUT Y:PRINT:PRINT:PRINT:PRINT
500 X=X/(L*W):D=1
510 IF L*W*D>=Y THEN 550
530 D = D +1
540 GOTO 510
550 X = X * Y
```

```
560 PRINTTAB(5)"IT WILL COST YOU $";X;" TO BUILD YOUR PROJECT, AND"
570 PRINT"YOU WILL NEED AT LEAST ";D;" BOARDS."
580 GOTO 1000
590 PRINTTAB(5)"WHAT IS THE COST OF A SINGLE BOARD IN DOLLARS";:INPUT X:PRINT
600 PRINTTAB(5)"HOW MANY SQUARE ";A$;" ARE IN THE SURFACE AREA"
610 PRINT"OF YOU PROJECT";:INPUT Y:PRINT:PRINT:PRINT:D=1
620 IF L*W*D >= Y THEN 650
290 B=T*W*L
300 PRINTTAB(5)"THE VOLUME OF ONE BOARD IS ";B;" CUBED ";A$;"."
310 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
330 PRINTTAB(5)"DO YOU WANT TO CALCULATE THE TOTAL COST OF A"
340 PRINT"PROJECT? TYPE 'Y' OR 'N' (Y/N)";
350 C$=""
355 C$=INKEY$:IFC$=""THEN355
360 IFC$="Y" THEN 380
365 IF C$="N" THEN 1000
369 PRINT:PRINT:PRINT
370 PRINTTAB(5)"ILLEAGLE ENTRY, PLEASE TRY AGAIN.":PRINT:PRINT:PRINT
375 GOTO330
380 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
390 PRINTTAB(5)"WOULD YOU LIKE TO FIHURE THE PRICE OF A PROJECT BY...":PRINT
400 PRINTTAB(10)"A. THE TOTAL NUMBER OF ";A$;" IN THE PROJECT?"
410 PRINTTAB(10)"B. THE TOTAL NUMBER OF BOARDS IN THE PROJECT?":PRINT
420 PRINTTAB(5)"TYPE (A/B)"
430 C$=INKEY$:IFC$="" THEN 430
435 IF C$="A" THEN 470
440 IF C$="B" THEN 590
445 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
450 PRINTTAB(5)"ILLEAGLE ENTRY, PLEASE TRY AGAIN.":PRINT:PRINT:PRINT
460 GOTO 390
470 PRINTTAB(5)"WHAT IS THE COST OF A SINGLE BOARD IN DOLLARS";:INPUT X
480 PRINTTAB(5)"HOW MANY SQUARE ";A$;" ARE IN THE SURFACE AREA"
490 PRINT"OF THE PROJECT";:INPUT Y:PRINT:PRINT:PRINT:PRINT
500 X=X/(L*W):D=1
510 IF L*W*D>=Y THEN 550
530 D = D +1
540 GOTO 510
550 X = X * Y
560 PRINTTAB(5)"IT WILL COST YOU $";X;" TO BUILD YOUR PROJECT, AND"
570 PRINT"YOU WILL NEED AT LEAST ";D;" BOARDS."
580 GOTO 1000
590 PRINTTAB(5)"WHAT IS THE COST OF A SINGLE BOARD IN DOLLARS";:INPUT X:PRINT
600 PRINTTAB(5)"HOW MANY SQUARE ";A$;" ARE IN THE SURFACE AREA"
610 PRINT"OF YOU PROJECT";:INPUT Y:PRINT:PRINT:PRINT:D=1
620 IF L*W*D >= Y THEN 650
630 D=D + 1
640 GOTO620
650 PRINTTAB(5)"IT WILL COST YOU $";X*D;" TO BUILD YOUR PROJECT,"
660 PRINT"AND YOU WILL NEED ";D;" BOARDS."
1000 PRINT:PRINT:PRINT
1010 PRINTTAB(5)"WOULD YOU LIKE TO CALCULATE THE BOARD UNITS FOR"
1020 PRINT"ANOTHER PROJECT? TYPE (Y/N)"
1030 PRINT:PRINT:PRINT
1040 C$=INKEY$:IF C$="" THEN 1040
1050 IF C$="Y" THEN 210
1060 IF C$="N" THEN 1090
1070 PRINTTAB(5)"ILLEAGLE ENTRY, PLEASE TRY AGAIN.":PRINT:PRINT:PRINT
1080 GOTO 1010
1090 END
```

```
]LIST

10  REM    THIS PROGRAM IS
20  REM DESIGNED TO GET THE I.A.
25  REM STUDENT USE TO USING THE
30  REM COMPUTER TO AID HIM OR
40  REM HER IN DOING HIS OR HER
50  REM PROJECTS.
60  REM
70  REM  THIS PROGRAM WILL
71  REM CONVERT BOARD FEET
80  REM TO BOARD CENTIMETERS.
205  REM
206  REM
207  HOME : PRINT : PRINT : PRINT

210  PRINT  TAB( 9)"***BOARD CONV
     ERT***": PRINT
220  PRINT  TAB( 9)"DETERMINING B
     OARD FEET KNOWING  THICKNESS
     , WIDTH, AND LENGTH."
230  PRINT : PRINT : PRINT : PRINT

245  PRINT  TAB( 3)"GIVE THE DIME
     NSION OF THE BOARD": PRINT :
      PRINT
250  PRINT  TAB( 3)"HOW MANY INCH
      THICK ";: INPUT T
251  REM
252  REM CONVERT INCHES THICK
253  REM TO FEET.
260  PRINT : PRINT : PRINT
270  PRINT  TAB( 3)"HOW MANY INCH
     ES WIDE ";: INPUT W: PRINT :
      PRINT : PRINT
280  PRINT  TAB( 3)"HOW MANY FEET
      AND INCHES LONG": PRINT
281  PRINT  TAB( 15)"FEET    ";: INPUT
     L1
282  PRINT  TAB( 15)"INCHES ";: INPUT
     L2
283 L1 = L1 * 12:L = L1 + L2
285  HOME : PRINT : PRINT : PRINT
     : PRINT
290 B = T * W * L
291 BF = B / 144
292  REM COVERT CUBED FEET TO
293  REM CUBED CENTIMETERS.
294  REM
295 C = B * 16.387064
296  PRINT  TAB( 5)"THE VOLUME OF
      THE BOARD IS:"
297  PRINT : PRINT  TAB( 10);B;"
     CUBIC INCHES": PRINT
298  PRINT  TAB( 10);BF;" BOARD F
     EET"
299  PRINT
300  PRINT  TAB( 10);C;" CUBIC CE
     NTIMETERS"
390  PRINT : PRINT
400  PRINT "WHAT IS THE COST PER
```

```
250  PRINT  TAB( 3)"HOW MANY INCH
      THICK ";: INPUT T
251  REM
252  REM CONVERT INCHES THICK
253  REM TO FEET.
260  PRINT : PRINT : PRINT
270  PRINT  TAB( 3)"HOW MANY INCH
     ES WIDE ";: INPUT W: PRINT :
      PRINT : PRINT
280  PRINT  TAB( 3)"HOW MANY FEET
      AND INCHES LONG": PRINT
281  PRINT  TAB( 15)"FEET    ";: INPUT
     L1
282  PRINT  TAB( 15)"INCHES ";: INPUT
     L2
283 L1 = L1 * 12:L = L1 + L2
285  HOME : PRINT : PRINT : PRINT
     : PRINT
290 B = T * W * L
291 BF = B / 144
292  REM COVERT CUBED FEET TO
293  REM CUBED CENTIMETERS.
294  REM
295 C = B * 16.387064
296  PRINT  TAB( 5)"THE VOLUME OF
      THE BOARD IS:"
297  PRINT : PRINT  TAB( 10);B;"
     CUBIC INCHES": PRINT
298  PRINT  TAB( 10);BF;" BOARD F
     EET"
299  PRINT
300  PRINT  TAB( 10);C;" CUBIC CE
     NTIMETERS"
390  PRINT : PRINT
400  PRINT "WHAT IS THE COST PER
     BOARD FOOT $";: INPUT D
405 P = D * BF
406 P =  INT (P * 100):P = P / 10
     0
410  PRINT : PRINT
411  PRINT  TAB( 3)"THE COST OF T
     HE BOARD IS $ ";P
415  PRINT : PRINT : PRINT "TYPE
     'RUN' AND <RETURN> TO WORK A
     NOTHER BOARD FOOT PROBLEM"
420  END

]
```

APPENDIX B: Microcomputer Programs for the Industrial Arts Computer Applications Guide

This documentation provides the following information about the programs prepared at Texas A&I University for the Industrial Arts Computer Applications Guide:

1. General Description of the Programs
2. Notes on Translation to Other Microcomputers
3. Documentation on Each of the Programs
    a. Work Records
    b. Bill of Materials
    c. Photo Dilutions
    d. Resistor Code
    e. Machine Shop Calc

GENERAL DESCRIPTION OF THE PROGRAMS

These programs are intended to provide computer activities for industrial arts and technology students. They can be divided into two general types: (1) calculation or planning aids and (2) industrial management simulations.

Calculation or planning programs are used to perform the calculations necessary for a project or to teach a concept. Machine Shop Calc, Photo Dilutions, Resistor Code, and Bill of Materials are programs of this type. These programs or their component parts can be used as a teaching aid by having the student perform the calculations alone, then checking with the computer for the correct answers. Of course, the teacher can also use the programs to check student answers to individual problems.

Work Records and Inventory (in preparation) are examples of management simulation programs. Using their own laboratory projects and work as an example, students can be introduced to the computer as an industrial management tool with these programs. These programs may also be used by the teacher for class management.

The programs were written to be as simple as possible and yet provide some sophistication in error catching and performance. Some include number formatting routines (Resistor Code and Bill of Materials) to make their output easily readable. Work Records and Inventory provide disk storage of data and sorting routines. Printer output is available in some of the programs to give summary reports.

NOTES ON TRANSLATION TO OTHER MICROCOMPUTERS

All of the programs were written for the Apple II+ and its clones: Franklin, Pineapple, Bel-ron, etc. While the unmodified programs will run only on these computers, they were written with a minimum of machine-dependent commands so that most could be easily converted to any microcomputer using one of the variations of Microsoft BASIC. The BASIC Conversions Handbook for Apple, TRS-80, and PET Users (The Brain Bank, Hayden Books #5534) is recommended for anyone interested in conversions.

Most of the conversions have to do with screen format commands and graphics. Some of the general differences are listed below for some of the most popular microcomputers.

VIC-20 & Commodore-64: These computers use the command: PRINT "♡" to clear the screen, while Apple uses the command: HOME to do the same thing. The VIC-20 displays only 22 characters per line on the screen. All screen displays must be modified to take care of this. Programs that save data, such as Work Records and Inventory, must be modified to handle the different operating system of the Commodore computers.

Radio Shack TRS-80: The TRS-80 uses the command: CLS to clear the screen, while Apple uses the command: HOME to do the same thing. The PRINT AT command in TRS-80 BASIC can be used to format the screen in the same way that Apple uses HTAB and VTAB. Programs that save data, such as Work Records and Inventory, must be changed to use the TRS-80 operating system.

DOCUMENTATION ON EACH OF THE PROGRAMS

Work Records

General Description. This program is a simulation of a work attendance program that might be used for payroll purposes. In the classroom, the program keeps student attendance records. Terms such as work check-in, personnel, and shift are used to add an industrial flavor. Students are allowed to interact with the computer individually. This makes the program an excellent introduction to the keyboard and general computer operation.

Features. The program allows up to 50 students per class period and up to 50 days of attendance records to be stored on disk. Records are kept of current absences, total absences, days in record, and number of personnel in record. Both screen and printer reports are available for individual students and total class. Editing allows names to be added to or dropped from the records at any time. Error catching and a reset trap prevents students from inputting data that would "bomb" the system.

Use. The program is menu-driven and hence easy to use. The following outlines some considerations for use:

1. A file for each class period must be set up first. This file must be set up just before the students (personnel) enter their names in step 2. Selection 3, START NEW RECORDS, on the main menu will present you with a choice between using a previous name list or creating a new list. If no records exist, choose to create a new list. You will then be asked to enter the name or number of the shift (class period). This name will become the disk file in which the records will be stored.

2. After a shift name has been chosen, the computer will be ready for personnel name entry. At this point, each student can come up to the computer and enter his or her name. Names must be entered first name first, then space, then last name (no single letter names). As each name is entered, the computer will select a unique random number between 10 and 99 for that name. This number is the permanent personnel number for that student. This number is displayed on the screen and the student is advised to remember it (write it down). If a student misses the number, it can be obtained later by listing all personnel records. This student entry of names is protected against accidental resets, breaks, and blank names.

3. Once all the students have entered their names and received a personnel number, the teacher can leave this mode by entering a CONTROL-F (hold down the CTRL key, then press the F key, then press return) instead of a name. The program will sort the names by last name and then store the data on the disk. This file on the disk becomes a permanent record. The program will return to the main menu.

4. The names and their numbers can be listed on the screen or printer by choosing selection 2, REPORT CURRENT RECORDS, on the main menu. If you have not turned the computer off, you can use the records still in memory. Entering the shift name or number will retrieve the records from the disk. At this point, you will be asked if you want a printer report. If you choose a printer report (printer must be connected in slot 1), all information will go to the printer. Otherwise, everything goes only to the screen. You are then given a choice of a report on all personnel or individuals. Individual reports require that you have the individual's personnel number. A report of all personnel will give you those numbers. Reports can be generated at any time.

5. On each day after the names are entered, you should choose the daily check-in option on the main menu so that each student in the class can check in. The computer will ask for the shift number or name and then go to the check-in screen. At this point, each student can enter his or her unique number. The computer will record their attendance. When everyone has entered their number, enter CONTROL-F and the files will be updated.

6. If you have a name to add or drop, use selection 4, ADD/DROP NAMES, on the main menu. To drop a name, you must know the individual's personnel number. Added

names are assigned a unique number. You can use this mode to correct errors in the records.

7. Once a reporting period (six weeks, for example) has passed, the absence records may be cleared by starting a new record using an existing list (selection 3, then selection 1). The names and numbers will stay the same, but all absences will be zeroed.

8. Like anything else, this program is best learned by practice. Run the program, and make up some names to create a file. Write down the numbers, and run some daily check-ins. Get the computer to generate some reports.

Bill of Materials

General Description. This program will generate a screen or printer bill of materials. Materials which are priced by the board foot, square foot, square inch, linear foot, and piece may be entered. Total amount of material and cost are calculated. Different types of material can be entered, and a complete bill of materials generated.

Use. This program is menu-driven and very easy to use. The computer asks you for information about each material in a project. After the data is entered, amount and cost for a particular material is presented. When all materials have been entered, a summary bill of materials is done. This can be sent to the screen or to a printer (must be in slot 1).

Calculation Programs

This is a set of programs that can be used to calculate values used in several content areas. The names describe their purpose:

Photo Dilutions
Resistor Code
Machine Shop Calc (and its parts)

APPENDIX C: Using the VIC-20 as a Controller: VIC-20 User Port Description

The VIC-20 uses a 6522, a Versatile Interface Adapter (VIA) which contains two eight-bit ports A and B. Port A is used for the joystick and part of the keyboard inputs. Port B is left open for the user's application.

Each of the eight bits on port B is controlled with a Data Direction Register (DDR). This register controls the direction of the bits which can be set for input, output, or a combination of both. This register is accessible through memory location 37138. To set a bit of the port to output, a 1 needs to be placed into the corresponding bit of the DDR. To set a bit for input, a 0 needs to be entered into the DDR. For example, to set bit 7 of the port to input and rest to output, the statement "Poke 37138,127" needs to be entered. Poking 127 into the location places a binary 127 in the DDR. A binary 127 is bits 0-6 high and 7 low. A good understanding of binary numbers is helpful in this area. (See figure 1.) Next, to control the output levels of the bits that were set to output, the output register is controlled by the statement "Poke 7136,x". For example, Poke 37136,3 will place a high level at bits 0 and 1. Poke 37136,5 will place a high level at bits 0 and 2.

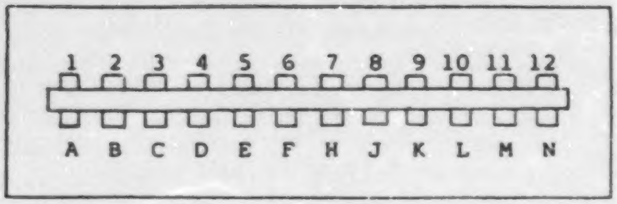
USER PORT
Bits PB0-PB7

7	6	5	4	3	2	1	0
128	64	32	16	8	4	2	1

Base 10 value

FIGURE 1

VIC 20 USER PORT CONNECTION



PIN#	NAME	NOTE	PIN#	NAME
1	GND		A	GND
2	+5	100mA MAX	B	CB1
3	RESET		C	PB0
4	JOY 0		D	PB1
5	JOY 1		E	PB2
6	JOY 2		F	PB3
7	LIGHT PEN		H	PB4
8	CASSETTE SWITCH		J	PB5
9	SERIAL ATN IN		K	PB6
10	+9	100mA MAX	L	PB7
11	GND		M	CB2
12	GND		N	GND

The user port uses a (12/24) Pin .156" spaced edge connector. The connector can be purchsed from many catalog supply companies. A connector and cable can be obtained from SMART ELECTRONIES, 1717 INDEPENDENCE PKWY., # 161, PLANO, TEXAS 75075 ,

COPIED FROM: VIC 20 Programmer's Reference Guide

APPENDIX D: Motor Controller

I must emphasize that this design is only a "research prototype." It works, but it has not been fully tested. If built correctly, it will not damage the computer since it is optically isolated from the motor drive electronics. You should be able to control DC motors which draw up to about 20 watts with no problem. Voltages may range from 5 to 15 volts. Keep the current under 1.5 amps using the listed transistors. **Do not** try to control high voltage (110-220) AC with this design.

Schematic

The enclosed schematic is the electronics necessary to control one motor. The other motor is controlled by an exact duplication of this circuit. The integrated circuits (4011 and 4070) decode the signal from the computer to allow control of the motor. These were necessary to allow both the VIC-20 and the Apple II+ to control the motors. If you build an interface just for the Apple II+, these can be left out so that you drive the LED portions of the opto-isolators through the 200 ohm resistors.

In the drawing, Vcc and the ground connections for the integrated circuits (4011 and 4070) are made to the computer. The Vmtr is the power for the motor and must come from a separate power supply. By using the opto-isolators (4N28), the computer is protected from the motor voltages. The PB0 and PB1 inputs are from the computer output port. In the VIC-20, they are designated PB0 and PB1 in the user port (pins C and D). PB2 and PB3 (pins E and F) are used to control the other motor. In the Apple II+ and IIe, they are annunciators Ann.0 and Ann.1 in the game port (pins 15 and 14). Ann.2 and Ann.3 (pins 13 and 12) are used for the other motor. See the interface cable section for details.

PC Board Layout

This PC board design was created using Bishop Graphics materials. The reproduction included is full size and can be photographed to produce a negative. Blank circuit board, photo resist, and etching materials are available from Radio Shack. If you are daring, you could lay out the design directly on a piece of PC board using a photo resist pen, then etch it. A Sanford Sharpie marker is good (and cheap) for this purpose.

The section of the PC board containing the 4093 Schmitt trigger is not needed to run the motors. It was put on the board to allow a means of input to the computer at a later time.

Parts Overlay and List

You can make reasonable substitutions for many of these parts. The resistor values given are those used in the prototype, but can have the range of values given. The transistors and opto-isolators listed were used in the prototype and can be varied as long as the pinout is the same (some alternatives are given).

Interface Cable for Apple II+ and VIC-20

The computer interface cable for both the Apple II+ and the VIC-20 is the same on the end which plugs into the motor controller. You can use a piece of ribbon cable like on the prototype, or separate wires in a multiconductor cable. The plug is a 16-pin DIP plug. Most of these have a corner cut off to indicate the number one pin. Make sure that you never short the + Vcc and ground together or connect the computer outputs directly to either + Vcc or ground.

Apple II+, IIe. The computer end of the interface cable for the Apple II+, IIe plugs into the game port. A schematic of this cable is supplied.

VIC-20. The computer end of the interface cable for the VIC-20 calls for a 12/24 pin (.156" spacing) plug for the user's port. This edge connector can be purchased from Advanced Computer Products (see surplus list). The top row of pins on the VIC is numbered. Check the book that came with the VIC for details.

Software

Apple II+, IIe. The motor controller is switched by using the game port of the Apple. There are four output lines (or annunciators) available. Each of these outputs is controlled by poking or peeking to a pair of memory addresses. One address turns the output on (makes it positive 5 volts) while the other address turns the output off (makes it 0 volts). This is a very simple procedure from a BASIC program.

A listing of the demo program used in the inservice is included. It was written on an Apple IIe (the only changes for the II+ would be to make all lowercase letters, uppercase). Most of this program is used to create the menus used to tell the user what to do and to display the moves. The actual control portions are small. They are the subroutines located at 1000, 1050, 1100, and 1150. Each routine causes a series of things to happen. First, a POKE command turns on the correct outputs to cause the two motors to run in a particular direction (the memory locations were defined as variables in lines 10 and 20). Each motor can go backwards or forwards so all moves are a combination of individual motor directions. Second, a time delay in the subroutine at line 1200 determines how long the motors will stay on. Finally, a POKE command turns off the motors. These subroutines can be used in any program to control the outputs to the motors. Check the Apple II+ Reference Manual for more details.

Commodore VIC-20. The VIC-20 user's port is controlled by a two-stage set of POKE commands. The first stage sets the in/out port up as an output port. A POKE 37186,255 command at the beginning of the program sets all lines to outputs (see The VIC-20 Revealed or The VIC-20 Programmer's Reference Manual for details). The second stage involves storing certain values in the output register. These values are decoded by the motor control circuit which in turn switches on the proper combination of motors to get a certain movement. The control portion of the VIC-20 program is listed below. The listing provided is not the entire program. You can refer to the Apple II+ listing for a general outline of the menus used in the program.

```
10  POKE 37138,255 : REM  sets up user port as output
```

The numbers poked into location 37136 determine the direction of the movement. The values poked into 37136 are:

Direction	Number in 37136	Binary
Forward	9	1001
Backward	6	0110
Turn Right	10	1010
Turn Left	5	0101

Other numbers can be used to control one motor at a time. Experiment!

The following lines illustrate how the motors are controlled from within the program. The value of D used in the delay loop determines how long the motors will stay on. For a stop (pause), just loop to D without turning on a motor.

```
500  POKE 37136,9    :  REM  TURN ON BOTH MOTORS (FORWARD)
500  FOR Z = 1 TO D :  NEXT : REM  TIME DELAY 'D'
500  POKE 37136,0    :  REM  TURN OFF BOTH MOTORS
```

APPLE II PROGRAM

```
]LIST

1  REM MOTOR CONTROLLER PROGRAM
5  REM INTIALIZE MEMORY LOCATIONS

10 G1 =  - 16295:G2 =  - 16293:G3
     =  - 16291:G4 =  - 16289
20 S1 =  - 16296:S2 =  - 16294:S3
     =  - 16292:S4 =  - 16290
99  REM  FIRST MENU
100  HOME : PRINT  TAB( 8)"MOTOR
     OPERATING SYSTEM"
105  POKE 34,2: REM  SET TOP OF P
     AGE
110  PRINT : PRINT  TAB( 6)"This
     program will allow you": PRINT
      TAB( 4)"to create a series
     of simulated": PRINT  TAB( 1
     )"moves on the BIG TRAK moto
     r interface."
120  PRINT : PRINT "You can do fi
     ve things:"
130 A$(1) = "Go Forward":A$(2) =
     "Go Backward":A$(3) = "Turn
     Right":A$(4) = "Turn Left":A
     $(5) = "Stop"
132  PRINT : FOR Z = 1 TO 5: PRINT
      TAB( 2)"<";Z;"> "A$(Z): PRINT
     : NEXT
134  PRINT  TAB( 6)"And you can d
     ecide how long"
135  PRINT  TAB( 10)"the motor wi
     ll run."
140  GOSUB 990: REM ASK FOR RETUR
     N
141  REM SECOND MENU
142  HOME : PRINT  TAB( 10)"< Mov
     e Selections >"
144  PRINT : PRINT "<GF> "A$(1) SPC(
     5)"<GB> "A$(2)
145  PRINT : PRINT "<RT> "A$(3) SPC(
     5)"<LT> "A$(4)
146  PRINT : PRINT  TAB( 15)"<ST>
      "A$(5)
150  PRINT : PRINT "First, enter
     the type of move you want,":
      PRINT "then enter the amoun
     t of time for that": PRINT "
     move from 1 to 30 seconds."
160  PRINT : PRINT "When you are
     ready to quit, enter a 'Q'"
170 C = 1
180  GOSUB 1800: REM INPUT VALUES
181  IF A$ = "Q" THEN 260
182  IF A$ = "GF" THEN 190
183  IF A$ = "GB" THEN 190
184  IF A$ = "RT" THEN 190
185  IF A$ = "LT". THEN 190
186  IF A$ = "ST" THEN 190
187  IF  VAL (A$) >  = 1 AND  VAL
     (A$) <  = 30 THEN 190
188  GOTO 180
190  IF  LEN (A$) < 2 THEN A$ = "
     0" + A$: GOTO 190
240  VTAB 18: HTAB C: PRINT A$
245 M$ = M$ + A$
250 C = C + 2: GOTO 180
260  VTAB 18: HTAB C: PRINT A$
265 M$ = M$ + A$ + "Q"
290  REM  RUN PAGE
300  HOME
310  PRINT : PRINT "You can now r
     un this set of moves."
320  PRINT : INPUT "Enter the num
     ber of repetitions: ";N
321  PRINT : PRINT : PRINT "Your
     moves:"
322  PRINT
325 P = 1
330  FOR X = 1 TO N
340 A$ =  MID$ (M$,P,2)
341  PRINT A$;
342  IF A$ = "QQ" THEN 410
345  IF A$ = "GF" THEN M = 1
346  IF A$ = "GB" THEN M = 2
347  IF A$ = "RT" THEN M = 3
348  IF A$ = "LT" THEN M = 4
349  IF A$ = "ST" THEN M = 5
350 P = P + 2
360 A$ =  MID$ (M$,P,2)
361  PRINT A$" ";
370 D =  VAL (A$) * 1000
380  ON M GOSUB 1000,1050,1100,11
     50,1200
390 P = P + 2
400  GOTO 340
410  PRINT :P = 1: NEXT
420  GOTO 1500
989  POKE 34,0: END
990  VTAB 23: PRINT "Press 'RETUR
     N' to continue:";
991  GET A$: PRINT : RETURN
```

```
1000  REM  FORWARD
1020  POKE G1,0: POKE G4,0
1025  GOSUB 1200
1030  POKE S1,0: POKE S4,0: RETURN

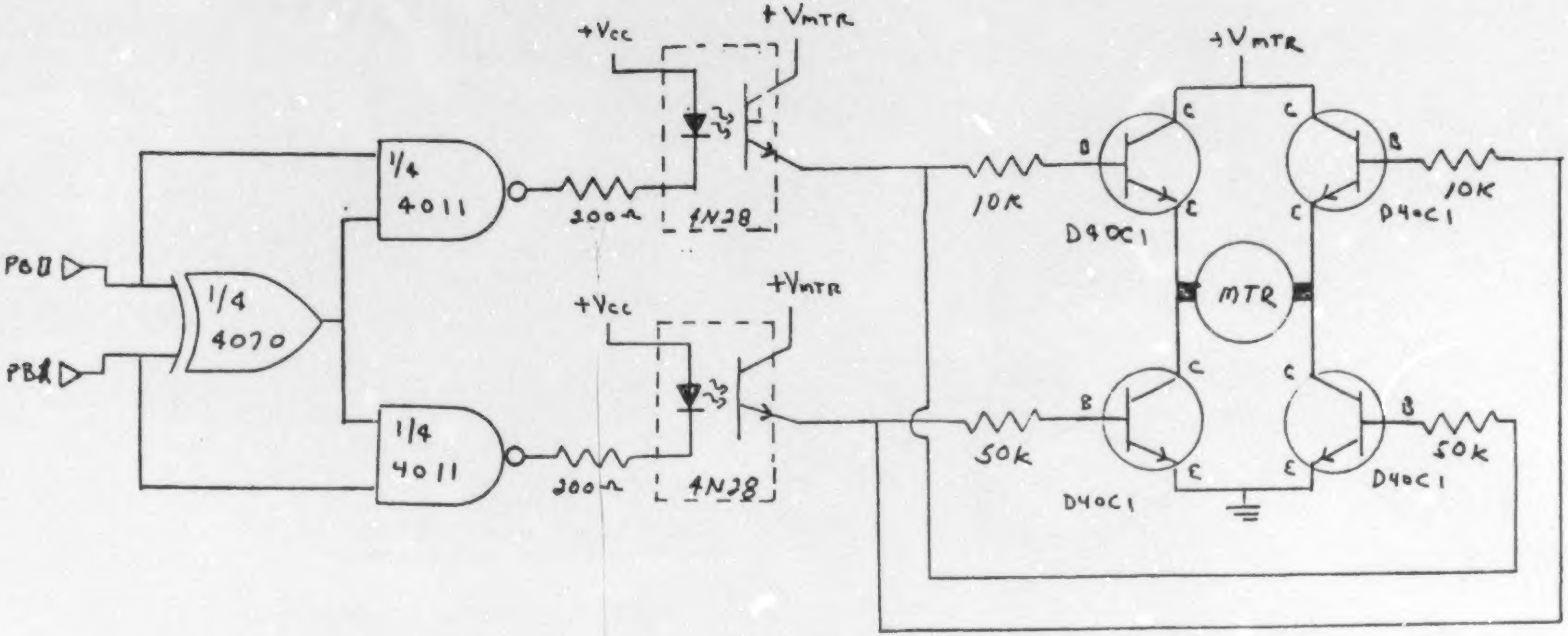
1050  REM  REVERSE
1070  POKE G2,0: POKE G3,0
1075  GOSUB 1200
1080  POKE S2,0: POKE S3,0: RETURN

1100  REM  RIGHT TURN
1120  POKE G2,0: POKE G4,0
1125  GOSUB 1200
1130  POKE S2,0: POKE S4,0: RETURN

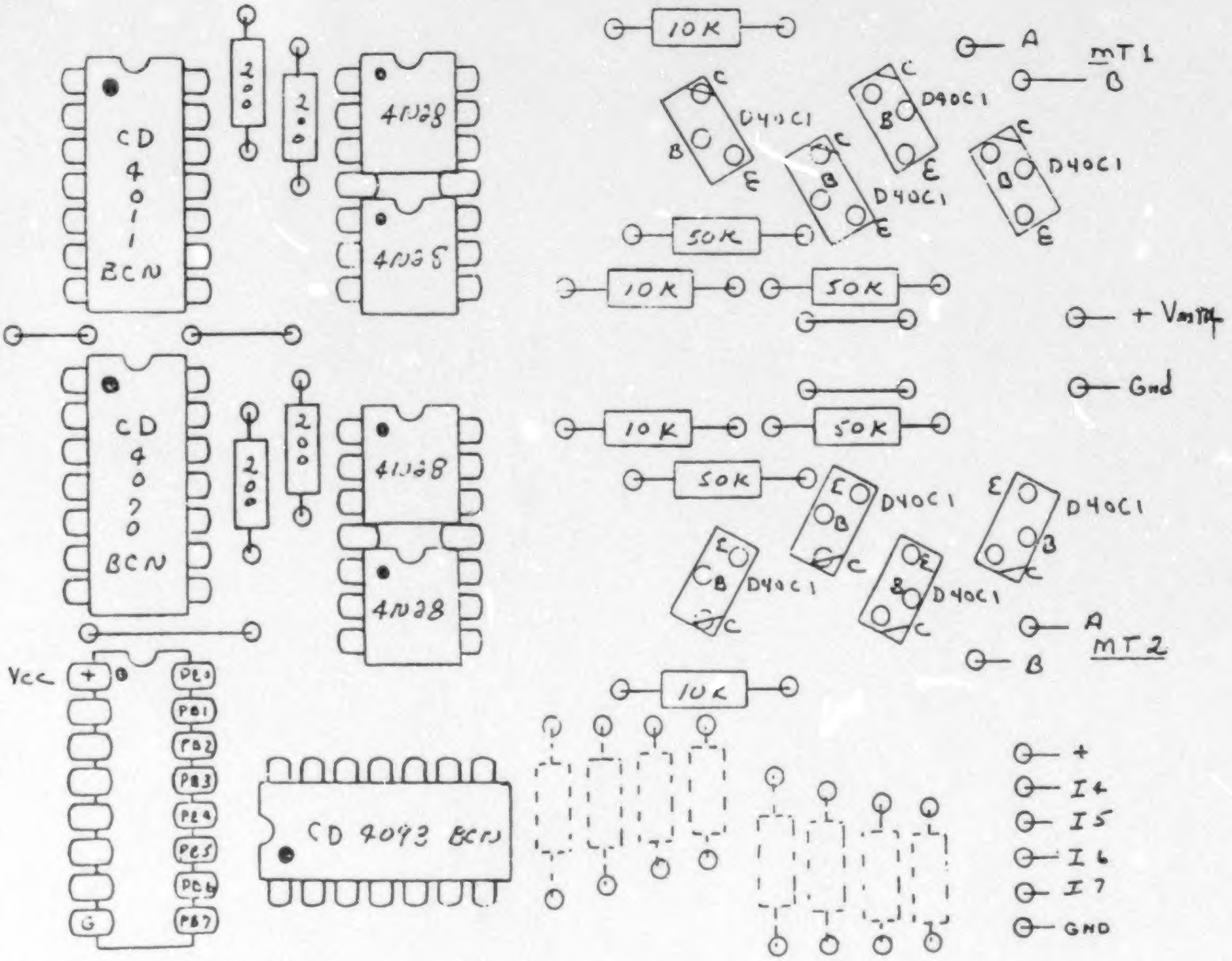
1150  REM  LEFT TURN
1170  POKE G1,0: POKE G3,0
1175  GOSUB 1200
1180  POKE S1,0: POKE S3,0: RETURN

1200  REM  DELAY
1210  FOR Z = 0 TO D: NEXT : RETURN

1800  VTAB 23: CALL  - 958: HTAB
     1: INPUT "Next: ";A$
1810  RETURN
```


+Vcc
+VMTR
1/4 4011
200Ω
4N28
PB0
PB1
1/4 4070
+Vcc
+VMTR
1/4 4011
200Ω
4N28
+VMTR
10K
B
C
E
D40C1
MTR
10K
D40C1
50K
D40C1
50K
D40C1

MOTOR CONTROLLER SCHEMATIC

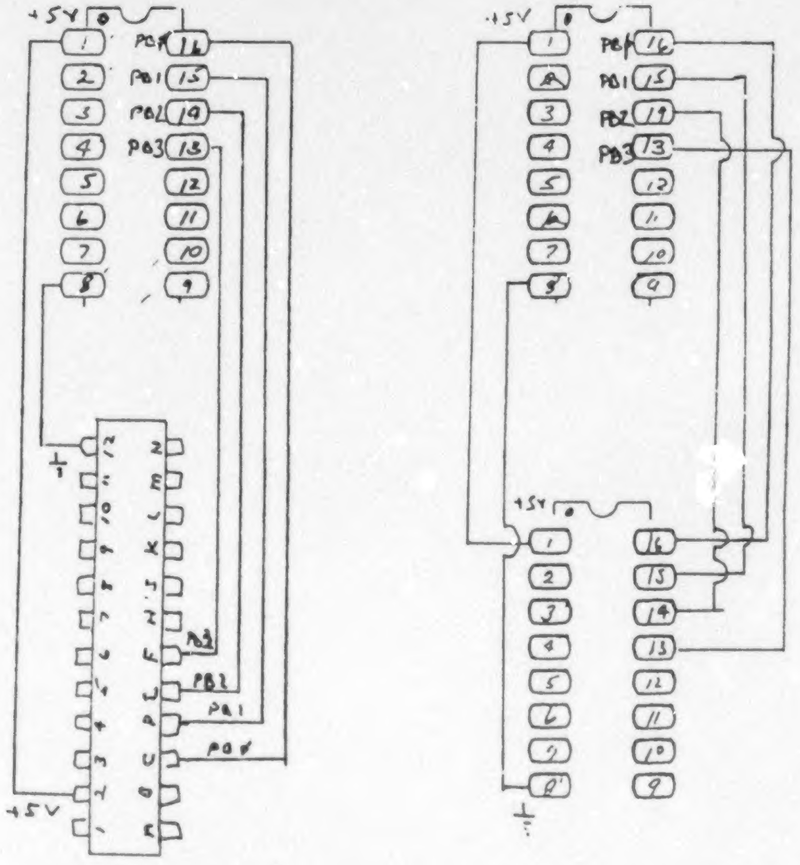

CD 4011 BCN
200
200
4N28
4N28
10K
50K
D40C1
C
B
E
A
B
MT1
+ Vmtr
Gnd
CD 4070 BCN
4N28
4N28
MT2
Vcc
+
PB0
PB1
PB2
PB3
PB4
PB5
PB6
PB7
G
CD 4093 BCN
I4
I5
I6
I7
GND

MOTOR CONTROL

MOTOR CONTROLLER PARTS LIST

1 - CD 4011 BNC CMOS QUAD 2-INPUT NAND GATE
1 - CD 4070 BNC CMOS QUAD 2-INPUT EX-OR GATE
4 - 4N28 Opto-Isolators
8 - D40C1 (MU45) NPN Darlington Transistor
4 - 200 to 330 ohm Resistors (1/4 watt)
4 - 10K to 27K ohm Resistors (1/4 watt)
4 - 47K to 62K ohm Resistors (1/4 watt)
4 - 14 pin DIP Sockets
1 - 16 pin DIP Socket

INTERFACE CABLES

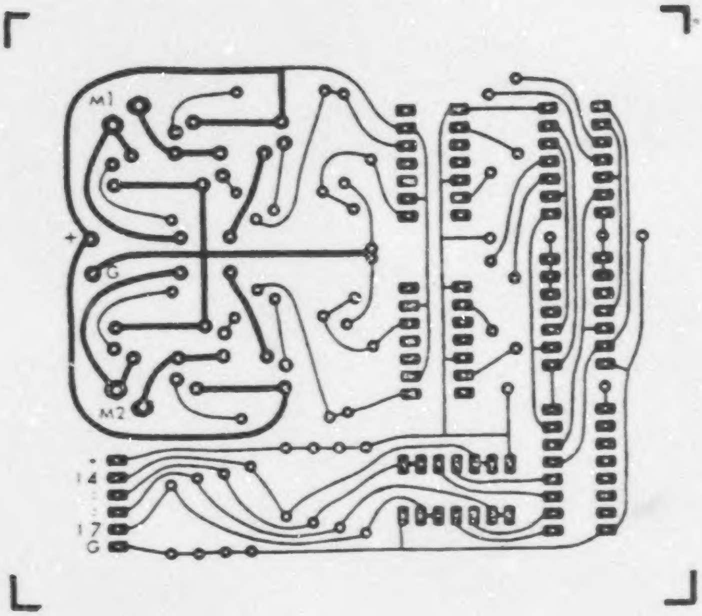


VIC-20 USER'S PORT

APPLE II+ GAME PORT

MOTOR CONTROLLER

PC BOARD


M1
+
G
M2
14
17
G